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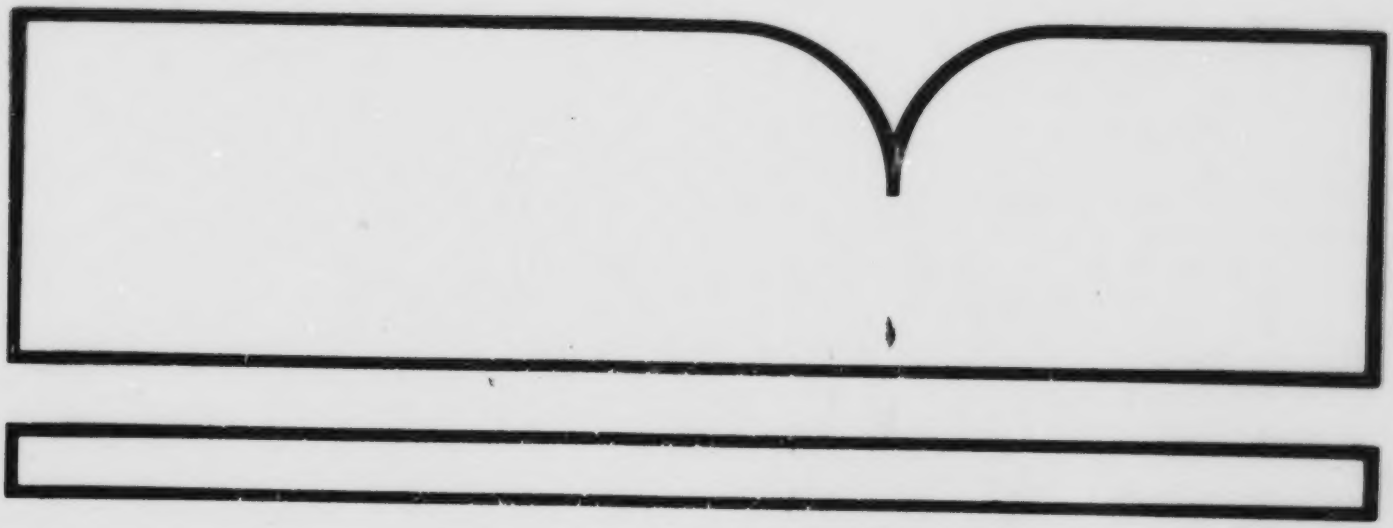

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This study addresses the development of compliance monitoring and enforcement strategies for one major source category of VOC emissions--the gasoline marketing chain. The study draws on the enforcement practices of agencies with several years of experience in implementing VOC rules for the gasoline marketing chain to suggest a framework for the use of state and local agencies in developing appropriate compliance strategies geared to local conditions. Rather than providing technical assistance on particular control techniques, the report highlights the factors that agencies should consider in deploying their enforcement resources. Volume I of the study presents the results of our survey of experienced agencies as well as the framework for development of compliance strategies. Volume II provides technical detail on the components of the gasoline marketing chain, the emission sources and control techniques, and the status of state emission regulations applicable to the chain.

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ABSTRACT

This study addresses the development of compliance monitoring and enforcement strategies for one major source category of VOC emissions -- the gasoline marketing chain. The study draws on the enforcement practices of agencies with several years of experience in implementing VOC rules for the gasoline marketing chain to suggest a framework for the use of state and local agencies in developing appropriate compliance strategies geared to local conditions. Rather than providing technical assistance on particular control techniques, the report highlights the factors that agencies should consider in deploying their enforcement resources. Volume I of the study presents the results of our survey of experienced agencies as well as the framework for development of compliance strategies. Volume II provides technical detail on the components of the gasoline marketing chain, the emission sources and control techniques, and the status of state emission regulations applicable to the chain.

ACKNOWLEDGMENTS

Undertaking a study covering a broad spectrum of specific subjects such as this one requires individuals with diverse kinds of expertise to work together in addressing the overall questions. Work on this study was greatly facilitated by the following individuals on the SRI project team.

The regulatory analysis was conducted by Richard A. Ferguson, Manager of SRI's Regulatory Analysis and Management Program (RAMP). The survey of regulations was conducted by Perrin Quarles, of Perrin Quarles Associates. Carl A. Trexel and Claudia Grill from the SRI Energy Center participated in collecting information on the gasoline marketing chain. Dr. Edward M. Liston from the SRI Atmospheric Sciences Laboratory developed information on emissions and emission controls. Harold R. Winslow, Jr., also from RAMP and Susan H. Russell from the SRI Center for Quantitative Social Sciences designed the procedures and format for conducting the interviews with enforcement agency staff. Those who conducted the interviews and interpreted and analyzed the results besides myself were Mr. Winslow, Mr. Ferguson, Mr. Quarles, Dr. Liston, and Mr. Roy L. Hays from the Center for Resource and Environmental Systems Studies. Finally, we wish to acknowledge the thoughtful critique and suggestions for improving the final version of this report made by Ms. Elizabeth H. Temkin from RAMP.

Beyond the resources of the SRI project team, much of the information on inspection and enfocement practices presented in Volume I came from interviews with staff of state and local air pollution control agencies, as well as EPA Regional Offices. We are especially grateful to these individuals who agreed to be interviewed and who provided us with insights and information on the topic that was otherwise unobtainable. In keeping with our assurances to interview respondents, we have not attributed any information in this report to specific agencies or individuals.

Richard L. Goen, Project Leader
Center for Resource and
Environmental Systems Studies

I INTRODUCTION

Background

Over the past 10 years, as air pollution control agencies have successfully established control programs to meet initial air quality goals, enforcement efforts have turned to previously unregulated emission problems. Thus agencies have had to grapple with new types of control techniques, often with virtually no increase in resources, while maintaining and monitoring existing programs.

The promulgation of regulations designed to control emissions of volatile organic compounds (VOC) in a wide variey of source categories highlights the problems of agencies confronting this paradox of success. Once the VOC regulatory process is complete, agencies will be responsible for enforcing control requirements involving invisible and hard-to-detect emissions from an almost bewildering array of large and small industries and processes. Necessarily then, VOC control techniques represent a significant departure from the more familiar SO_2 and TSP control approaches and agencies may well need technical assistance to master these new types of compliance monitoring and enforcement techniques.

In terms of the effectiveness of an agency's overall enforcement effort, however, technical assistance on source-specific enforcement problems is valuable only to the extent that it is structured in terms of: (1) the need for flexibility in ensuring initial control and continuing compliance across disparate groups and sizes of sources; and (2) the fact that the main objective of an enforcement program in a time of expanding responsibilities and shrinking resources must be to achieve source compliance and not necessarily to maximize the number of lawsuits filed.

Given these requirements, the need arises to design what we term "compliance strategies," which, as used in this report, include not only formal inspection and enforcement techniques, but also the manner in which agency resources are deployed, the use of incentives and nontraditional enforcement mechanisms, as well as the strategic use of formal sanctions. The characteristics of the VOC problem--the number and types of sources, the nature of the pollutant, and the nontraditional mix of required control techniques--highlight the importance of planning an individually appropriate compliance strategy as the key to a successful VOC enforcement program.

Scope

EPA's Division of Stationary Source Enforcement (DSSE) asked SRI to study the development of compliance monitoring and enforcement strategies for one major source category of VOC emissions--the wholesale gasoline marketing chain.

The gasoline marketing chain was selected from the various VOC source categories for a number of reasons. First, it is one of the major sources of total VOC emissions. Second, several state and local agencies have been involved in controlling gasoline marketing emissions for a number of years, an important consideration given that we wanted to examine, firsthand, strategies presently in use. Third, the gasoline marketing chain is in many ways a useful starting-point for understanding the VOC area as a whole. While sharing several characteristics of other VOC source categories--invisible emissions, many sources, problems of minor violations (leaks, fugitive emissions)--gasoline marketing presents a somwhat more familiar compliance problem. For example, the use of add-on control techniques plus attendant operations and maintenance requirements have been integral to past enforcement efforts. Thus, we see gasoline marketing not so much as an example of the most challenging or least familiar of the new VOC sources, but rather as a useful vehicle for beginning to understand the nature of the transition from traditional control efforts to the new area of VOC control. In this context, we believe that the ideas presented on compliance strategy development for the gasoline marketing chain are a highly useful tool in approaching the general VOC control problems.

In addressing the question of compliance strategy development, this report presents a substantial body of information on technical aspects of inspection, enforcement and problems encountered with the control techniques. Inspection manuals and technical assistance are expected from EPA. However, the more immediate need is to assist state and local agencies in planning how to use these external resources to effectively implement a gasoline marketing compliance strategy within the context of other responsibilities and constraints affecting the availability and magnitude of local resources that may be applied to gasoline marketing chain enforcement.

We believe that national-level guidance can play a significant role in the development of individual strategies so long as that guidance focuses not on creating uniformity but rather on the important factors and relationships to be considered in designing local enforcement programs. Thus, no all-encompassing strategy is specified in this report (and was not apparent among the agencies we studied). Rather, the report sets forth factors for consideration in assembling various techniques and relationships among them, aimed at assisting state and local agencies in developing locally useful and appropriate strategies.

Method of Approach

The method for this study involved three major sets of activities: a detailed description of the gasoline marketing chain, including its components, emissions and controls; a survey of pre-existing and new state regulations for controlling these sources; and an interview survey of agencies with experience in compliance activities for these sources. The gasoline marketing chain consists of refineries, bulk gasoline terminals, bulk gasoline plants, tank trucks, and service stations. Our study excluded refineries and service stations because we wanted to concentrate on a related set of sources having operations and controls of similar complexity.

On this basis, we began by describing the gasoline marketing chain, the emissions sources, and control techniques with some specificity. After identifying the number of elements in the chain, we describe how many of them are in areas where controls are or will be required. State regulations affecting components of the chain are summarized, and the older regulations are contrasted with the more stringent and comprehensive requirements under the 1977 Clean Air Act Amendments.[a] Using this information, we then designed and conducted an on-site interview survey of staff members at agencies that had several years of experience implementing and enforcing regulations for vapor control along the gasoline marketing chain.

The survey was conducted in six states contained in three EPA regions selected on the basis of experience with VOC regulations and geographic diversity. In all, 19 EPA regional, state, and local agencies were visited with an average of three to six interviews conducted at each site. Our procedure was first to visit the EPA regional office to discuss our study and get the regional perspective on the issues involved. Next, we visited the state agency, conducting a round of interviews there before proceeding to the selected local agencies. The local agencies were the primary focus of our interview effort.

To achieve as broad a perspective as possible, we conducted interviews with various kinds of agency staff, including directors of inspection and enforcement, inspectors, engineers, attorneys, and field supervisors. We discussed staff functions, the agencies' organization, inspection practices and strategies, enforcement activities, and the particular incentives and sanctions used by and available to agencies. Finally, we asked our agency respondents for their ideas on strategies that might be pursued by others just commencing VOC enforcement. Working from a topical outline, we structured the interviews around the particular respondent so as to focus on the respondent's area of expertise. In all, we sought to achieve a comprehensive look at what

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[a]This material is contained in Volume II of the report.

experienced agencies are doing to enforce VOC rules along the gasoline marketing chain.

Although we generated a wealth of interesting and useful information, the reader should keep in mind some important caveats. First, this study describes a survey involving a limited sample, which is not statistically or otherwise representative of agencies in general. It does provide, however, a good range of the experiences of agencies considered to have a good or active program. Second, as indicated above, our method was to conduct personal interviews with a diverse set of agency staff. On this basis, our activity was not and should not be considered a program audit or evaluation. Rather, we attempted to solicit ideas and approaches for devising practical solutions to enforcement problems.

Organization of the Report

This report is divided into two volumes. Volume One contains a summary of the entire study (Chapter II), and findings and conclusions from our interviews with personnel in agencies across the country experienced in VOC enforcement (Chapters III through V). Appendix to Volume One presents case studies of four agencies to show how representative agencies have combined the elements discussed in the body of the report. Appendix B presents reviews of the draft of this report.

Volume Two contains the information we developed on the gasoline marketing chain and the status and content of state regulations. Included is a description and inventory of the components of the chain (Chapters I and II), the magnitude of VOC emissions and the applicable controls (Chapter III), and the status of VOC emission regulations among the states (Chapter IV).

II SUMMARY

The Gasoline Marketing Chain

The gasoline marketing chain consists of terminals, bulk plants, service stations and other gasoline-dispensing facilities, and transportation components, including pipelines, tankers, barges, tank trucks, and rail tank cars.

Terminals are large facilities for the wholesale marketing of gasoline, kerosene, and fuel oil. They receive gasoline from refineries by pipeline, tanker, and barge, and distribute gasoline by tank truck to bulk plants, service stations, and other gasoline-dispensing facilities.

Bulk plants are smaller facilities for the wholesale marketing of gasoline, kerosene, and fuel oil. They receive gasoline from refineries or terminals by tank truck and distribute gasoline by tank truck to service stations and other gasoline outlets.

Service stations receive gasoline by tank truck from refineries, terminals, or bulk plants, and dispense gasoline into fuel tanks of vehicles. Other retail outlets not defined as service stations and private facilities for fleet operations also dispense gasoline.

The following tabulation shows the number of these components of the gasoline marketing chain and their annual gasoline throughput:

	Number	Annual Gasoline Throughput (10^9 liters)
Terminals	1,800	497[a]
Bulk Plants	21,000	148
Service Stations	170,000	340
Other Gasoline-Dispensing Facilities	240,000	103

Of the terminals and bulk plants combined, 31% of the facilities and 73% of the throughput are in areas that are not in compliance with the 0.12-ppm standard for oxidants.

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[a]The throughput of the terminals exceeds the total consumption of gasoline because of transfers between terminals.

VOC Emissions and Emissions Controls

The principal sources of VOC emissions within the gasoline marketing chain are (1) working losses from vapor displacement during transfer between storage tanks and tank trucks or water carriers, (2) vapor displacement during fueling of vehicles, and (3) breathing losses from storage tanks.

These emissions can be controlled either by reducing the production of vapor or by collecting and processing the vapor. The production of vapor can be reduced by submerged fill rather than splash loading of storage tanks, tank trucks, and water carriers. Floating roofs on gasoline storage tanks at terminals also reduce the production of vapor.

At terminals, the vapor from storage tanks and tank trucks can be collected and converted back to liquid gasoline (by either refrigeration or adsorption/absorption systems) or burned. The control of emissions from tankers and barges at marine terminals is more difficult and the technology is less developed.

At bulk plants, the vapor displaced from the storage tanks as the tanks are filled can be transferred to the truck that is filling the storage tank for return to the terminal or refinery for processing. When trucks are loaded, the displaced vapor from the truck can be transferred to the storage tank from which the truck is being loaded.

At service stations, while storage tanks are being filled, the vapor displaced from the tanks can be transferred to the truck for return to the bulk plant, terminal, or refinery. When gasoline is pumped into vehicles, the vapor displaced from the vehicle fuel tanks can be transferred to the service station storage tank using either a vapor balance system or a vacuum-assist system. Alternatively, a canister can be installed on the vehicles to capture the vapor.

The total annual VOC emissions at the terminals, bulk plants, service stations, and other outlets, without vapor control other than submerged fill of all tanks and transport vehicles, would be 1.8 million metric tons. If splash fill were used with all tank trucks and tanks at service stations and other outlets, the annual emissions would be approximately 2.5 million metric tons. Actual current emissions fall somewhere within that range. With vapor control for all elements other than tankers and barges, annual emissions could be reduced to 160,000 metric tons, if all equipment were working properly, or to 110,000 metric tons with controls on tankers and barges also.

VOC Emission Regulations

The Clean Air Act Amendments of 1977 require states to adopt and submit revised State Implementation Plans (SIPs) to meet the oxidant standard by 1982, with a possible extension to 1987. Where a state cannot reasonably attain the standard, the plans must require the

application of reasonably available control technology (RACT) to existing sources of VOC emissions. The EPA guidelines for RACT applicable to terminals and bulk plants specify submerged fill of tanks, vapor controls on storage tanks with capacity greater than 152,000 liters (this excludes most tanks at bulk plants, but includes most tanks at terminals), vapor recovery or equivalent systems at terminals, and vapor balance systems at bulk plants.

All but 7 states have oxidant nonattainment areas. Officials in 37 states have indicated to us their intention of meeting RACT for VOC emission sources, and as of November 28, 1979, approximately 38 states had submitted offical revised SIPs for approval by EPA which contain oxidant provisions.

Before this year's SIP revisions, few states had existing regulations covering ships, barges, rail, and pipelines, but most had regulations applying at least to storage tanks at terminals. However, as a matter of state law, only 15 states have required vapor recovery or equivalent systems at terminals, and only 6 states currently require vapor controls at bulk plants.

With the new SIPs, many more states are incoprorating more substantial controls on terminals and bulk plants in their regulations. The states requiring vapor recovery systems for terminals are increased to 36, and the states requiring vapor balance systems for bulk plants are increased to 29. Also some states with existing controls expanded the number of sources to which the controls apply by reducing the minimum storage tank capacity or facility throughput for which the controls are required.

Findings from Survey of Agencies Experienced in VOC Compliance Activities

In our interviews of agency personnel, we determined what actions had been taken to address specific enforcement problems, and why. We obtained information both on inspection and monitoring as well as compliance and enforcement strategies. At each agency, we identified organizational and staffing arrangements, inspection practices, enforcement tools available, and formal and informal enforcement action that had been or was being taken against sources in the gasoline marketing chain.

Organization and Staffing

Organizational arrangements and staff types were very important in determining the approach taken to ensure compliance. Organizational arrangements could determine, for example, which staff would be available to undertake the source inspections and the manner in which notices of violation (NOVs) were proc ed. The type of staff devoted to VOC enforcement affected the degree of rigor with which the inspections were conducted and the extent to which violations were processed through formal enforcement mechanisms.

Inspection Techniques and Strategies

Because of the cost and expertise required to conduct source tests, the number of sources involved, and the varying priorities among pollution types and source categories, the agencies we visited had developed various forms of field inspections of sources within the gasoline marketing chain. We classified these into four types:

- Source tests
- Comprehensive inspections without source tests
- Routine inspections
- Spot checks.

The techniques used for each were similar, although less comprehensive (in terms of such factors as emission points checked and documents reviewed) and more frequent moving down the list from the source test to the spot check.

We found that experienced agencies employ more than one type of inspection, depending on the characteristics of the source and the agency itself. In addition, type and frequency of inspection technique will vary among individual sources, with problem sources tending to receive both more frequent and more comprehensive checks. The agency's evaluation of these elements tended to change markedly with circumstances.

Enforcement Techniques and Strategies

A mix of formal and informal enforcement techniques are used by persons responsible for enforcement. Enforcement strategies could be categorized in the following way:

- Adversarial strategies which assume little or no voluntary compliance and rely on existing inspection and enforcement staff employing sanctions (rather than incentives) to produce the desired source response

- Joint enterprise strategies which assume some level of willingness of the source to comply with the rules once promulgated and involve ways of identifying or creating incentives for the sources to comply.

These sets of strategies were found to involve varying combinations of tools such as the deployment of inspection staff, the appliction of both formal and informal sanctions, creation of incentives, and opening lines of communication with both the sources and other agencies.

Remaining Problems in Undertaking Compliance Activities

Even for those agencies highly experienced in enforcing VOC rules for the gasoline marketing chain, numerous problems exist that inhibit

fuller realization of the regulatory goals. These problems include the effectiveness of the control equipment, the difficulties in processing minor violations, the need for acceptable operations and maintenance practices by sources, and some issues involving agency recordkeeping.

The major problems associated with control effectiveness were identified as being downtime of the vapor recovey unit, belching (release of vapors through the pressure relief valve when unit capacity is exceeded), switch-loading (loading of uncontrolled fuels not having vapor return lines on the racks, resulting in loss of previously collected gasoline vapors), and top-loading of gasoline trucks. Significant controversy exists over the actual extent of downtime on VRUs. Technical resolution of the question is needed to specify the amount of inspection and enforcement resources that should be applied to this problem. The belching problem can be alleviated through better information about proper sizing as well as the installation of a cut-off switch on the racks to prevent exceeding VRU bladder capacity. Switch-loading problems could be resolved through requiring vapor return lines on racks used for loading uncontrolled fuels. Although the industry trend is toward bottom-loading, agency activities to speed this transition are recommended.

Our agency respondents generally agreed that the large number of minor violations identified through their inspections could not each be handled through the formal enforcement process, not only because of the time and expense involved, but also because of the problems of proof and of obtaining a meaningful penalty. Thus, either several violations by the same source were processed simultaneously or, more basically, solutions to the underlying problems that result in minor violations were conceived.

One major problem is the low quality of operations and maintenance (O&M) practices. Analyzing patterns of minor violations to ascertain specific O&M problems is one approach. To address this problem, local rules should authorize actions on the basis of a requirement that the equipment be "in good repair" or "in good working order," Violations of such rules can be remedied by placing the source on a maintenance plan or by attaching conditions to operating permits where they exist in the agency's rules. Such strategies for helping to remedy the numerous minor violations were perceived to be more effective than either individual processing or the banking of notices or violation for processing at one time.

The Development of Compliance Strategies: Conclusions from the Survey

Based on our study of the organization, staffing, inspection and enforcement activities of experienced agencies, we reached a number of major conclusions that we believe should be given serious attention by any agency in the process of developing compliance strategies for VOC regulations. Although these conclusions relate most directly to the gasoline marketing chain, we believe that many of the concepts are also applicable to other VOC sources.

1. Both because source tests are expensive and do not identify all existing problems and because of the large number of sources generally present within an agency's jurisdiction, a system of frequent on-site inspections less than a source test is needed. Agencies should determine resources available and overall enforcement strategies to serve as the basis for determining the types and frequencies of inspections they will conduct, as well as the manner in which inspection resources will be targeted to particular sources.

2. An agency's development of a compliance strategy should involve less the adoption of an ideal design and more the commencement of a process of relating conditions and characteristics of VOC, the source category, and the agency itself toward the development of individually satisfying and appropriate strategies. In other words, there is no single, ideal compliance strategy that will apply to all agencies.

3. In enforcing VOC regulation, informal or nontraditional means of achieving compliance are as important (if not more so) than formal ones. Different combinations of enforcement techniques are appropriate depending on such factors as agency type and style, staff available, and source characteristics.

4. Stages of implementation of new regulations require differing approaches and emphases. Besides those commonly thought of (rulemaking, compliance scheduling, equipment installation) there exist fairly distinct stages following installation, e.g., equipment shakedown, early continuing compliance, and later continuing compliance phases. Different inspection strategies and enforcement approaches appear to be applicable to the various states.

5. Even assuming an agency's adoption of all the appropriate techiques and the devising of an optimal compliance strategy, the resources required may still exceed those available. For VOC source categories beyond the gasoline marketing chain, this is almost certain to be the case. Thus, agencies should consider ways in which they can multiply their own effectiveness through the use of other agencies having related regulatory or programmatic interests.

6. Because the gasoline marketing chain is in many ways one of the more manageable of the VOC source categories, agencies should begin developing strategies for those other categories as they plan for gasoline marketing chain compliance activities. Similarities among the various source categories should provide several opportunities for devising strategies for VOC compliance as a whole.

III FINDINGS FROM SURVEY OF AGENCIES EXPERIENCED IN VOC COMPLIANCE ACTIVITIES

During our survey of personnel at agencies experienced in the enforcement of VOC rules for the gasoline marketing chain, we asked questions about organizational and staffing arrangements, inspection practices, enforcement tools available, and the kind of enforcement action typically taken against noncompliant sources. We also asked for the rationale behind what was done and solicited suggestions from respondents on how a new agency might effectively implement new VOC rules. Because the information received from the diverse agencies was frequently overlapping, we present the predominant techniques and strategies we observed in the chapter, noting significant variations where relevant. As an aid to understanding how the various elements described here were specifically fit together in particular agencies, we have included detailed case studies of four representative agencies we visited in Appendix A of this volume.

Organization and Staffing

The organizational arrangements and number and type of staff involved in VOC enforcement is an important factor in an agency's approach to compliance activities. Organizational arrangements could determine, for example, which staff would be available to undertake the source inspections and the manner in which notices of violation (NOVs) were processed. The type of staff devoted to VOC enforcement affected the degree of technical rigor with which inspections were conducted and the extent to which violations (particularly minor violations) were processed through the formal enforcement mechanisms.

Agency Types

Rather than presenting a detailed agency-by-agency description of organization arrangements, we developed a set of agency types based on the characteristics of our sample. Each of our sample agencies may be placed primarily within one of these types, although considerable overlap exists. The agency types (or stereotypes) we identified are:

- Commando Agency--One inspector, with limited technical background who relies on spot check inspections and output measures of compliance.

- Beat Cop Agency--Inspectors assigned to geographic regions; generally experienced staff; fairly routine NOV processing procedures.

- Technical Assistance Agency--Engineer with extensive technical expertise who goes into the field to help sources solve problems with equipment operation; formal enforcement actions rarely taken.

- Utopia--Inspection functions divided among various two-person teams; ample staff available; agency has own legal counsel and discretion in choice of civil or summary criminal enforcement actions available.

Because our sampling plan was designed to include a range of agency types and situations, we cannot state which agency type generally predominates. Nonetheless, a full review of agencies would likely show more of the Commando or Beat Cop Agency than the other two types.

The inspection strategy followed, the sanctions used (or not used), and the type of staff involved were different for each agency type. Commando and Technical Assistance Agencies both tended to rely solely on the activities of one key person, although the relative experience and capabilities of this staff member varies considerably. In contrast, the Beat Cop and Utopia Agencies tend to be more of a team effort while exhibiting a more routine enforcement mechanism than the other two. The major difference between the Beat Cop and Utopia Agency is the size of the staff working on VOC sources and the relative priority of VOC control. Utopia uses two-person inspection teams working solely on VOC sources, while Beat Cop has geographically assigned inspectors responsible for non-VOC sources as well. VOC has the highest priority in Utopia and substantially less in the Beat Cop Agency.

Staff Types

Although specific titles and organizational placements varied widely among our sample agencies, three basic types of staff exist in some combination in the agencies: engineers, expert inspectors, and control officers.[a] Engineers are those possessing the educational credentials for that title and frequently are responsible for a variety of source types. Expert inspectors either have extensive field experience or a substantial amount of education less than an engineering degree. This provides them with an expertise in the workings and operations of the control equipment. Control officers are generally those with high school, or 2-year degrees plus some on-the-job training. Frequently, the activities of control officers in the VOC area are added to the patrolling for visible emissions on other types of sources.

As a general rule, the type of staff available at the onset of VOC regulations determined the type used for the compliance program. Agencies did not hire special staff to implement VOC enforcement

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[a]These titles are used for purposes of discussion and do not necessarily reflect actual titles used.

activities. The one agency with a strong technical assistance strategy had a highly qualified engineer when the regulations became effective but no other field staff available. The control officers present at that agency were organizationally located in a separate division, and the engineer's supervisor had no authority to allocate the control officers' time for bulk terminal inspections. The supervisor told us that, with the inclusion of bulk plants in the regulations, he found the demand on the engineer's time to have become excessive. To provide greater coverage, he was planning to create a new staff category--"process evaluator"--to be composed of the more experienced control officers who would be trained by, and put under the supervision of, the engineer. This new staff categoy (anticipated to become like what we have termed expert inspectors) would be responsible for less technical aspects of inspection not requiring an engineer, and would serve to increase the frequency of inspections.

We found that an agency with expert inspectors tended to devote little or none of the engineers' time to field activities. The nature of inspections conducted and the capabilities of the expert inspectors were such that most violations could be documented adequately by that person. More technical questions could be referred to an engineer for consultation, although responsibility would remain with the inspector.

In a few agencies, control officials supplied the only inspection presence. In these places, inspections tended to he directed toward the identification of leaks and basic VRU problems. The control officers in this situation tended to have a good grasp of how to identify particular problems but a much less detailed understanding of the workings of the control technology.

Many agencies employ some combination of the above staff types. "Stack readers," or those control officers responsible for finding violations of visible emission regulations, were sometimes recruited to make quick checks of a terminal or a plant, or of off-loading at a service station. Engineers or expert inspectors would be involved in less frequent, more intensive inspections to which the quick checks served as a supplement. Control officers would occasionally accompany the engineers or expert inspectors on these more thorough inspections where it was felt that two persons were needed to accomplish the inspections.

Some unique staffing techniques that may have more extensive applicability were employed to deal with special problems. In one agency, a bulk terminal experienced considerable problems in getting its VRU operating properly. A control officer was given specific instructions on inspecting that particular VRU and was assigned to be at that terminal almost daily until the problem could be resolved. In another case, the agency staff had been unionized. The union claimed that climbing of storage tanks should not be required of expert inspectors, because it produced unreasonable physical demands on the older inspectors. This problem was solved by creating a separate tank-climbing unit to perform

this function on various types of sources (especially terminals and plants) within the agency's jurisdiction.

In general, we found that agencies adopt a variety of organizational and staffing strategies by taking into consideration the number of sources requiring inspection (relative to available manpower), the availability of particular staff persons by staff types (engineers, expert inspectors, control officers), the differing levels of expertise required to perform different parts of the inspections, and a perception of probable source responsiveness to the rules. This is not to say that all these variables were known to the agency when implentation began, or that the decision-making process was particularly discrete or conscious. It does indicate, however, that no one particular staffing arrangement was predominant among the agencies we visited and that different reasons for particular ones were offered by agency staff interviewed.

Inspection Techniques and Strategies

The need to develop field inspection procedures derived from the conclusion reached by nearly all seasoned agencies that source tests were simply not appropriate to the task in isolation and some additional means of apprehending rule violators was needed. Several factors worked to produce this conclusion. First, the cost and expertise required to conduct source tests tended to make their widespread use an unattractive option. Second, most agencies simply had too many sources within their jurisdiction to make source tests the only tool to apprehend violators. Third, most agencies had other priorities (e.g., different pollution types, different source categories) that precluded their investing in an extensive source testing program. Fourth, and perhaps most critical to enforcing compliance, source tests simply do not do the whole job. Typically, source tests have been limited to checking the operating efficiency of the VRU. While this is useful and important information, such tests cannot check on downtime nor periodic leakage. Thus, there is no assurance that, overall, the emission limitation is being met.

From the need to develop a system for apprehending violators without extensive reliance on source tests, a diverse set of inspection techniques was born, which involves an inspector being at the source to determine whether its operations are being conducted in compliance with the rules. A major finding from our survey was that no one type of inspection is undertaken by experienced agencies. Rather, different agencies employ differing types and frequencies of inspections. Further, within a given agency, the type and frequency will vary among individual sources, with problem sources tending to receive both more frequent and more comprehensive checks.

Under the normal state system, local agencies have the primary responsibility for enforcement. State agencies may conduct some inspections of sources but these tend to be as much to verify the efficiency of local inspections and for monitoring purposes as they are to identify

violations. EPA regional offices in areas where VOC regulations have been in place have conducted some inspections for similar reasons. We identified a few variations on this typical inter- governmental relationship. In one small state, the state agency is wholly responsible for compliance activities; in another, the state agency is responsible for those inspections calling for a greater level of expertise (e.g., refineries and bulk terminals) while local agencies perform the more routine inspections (e.g., to make sure equipment has been installed at bulk plants and service stations). In a couple of states, local agencies may become certified though promulgation of sufficiently comprehensive local rules and essentially take over enforcement for their geographic area. Finally some states maintain one or more expert inspectors to provide assistance as needed by the local agencies. In general, inspection occurred among all three levels of government in nearly all the states we visited. Most regular inspection activity, however, occurs at the local level.

Types of Inspections

We questioned inspectors and supervisors extensively about the techniques and procedures used to conduct inspections of gasoline marketing chain sources. We asked them to describe what was checked and how, not only during regularly scheduled inspections but also for any occasion when the inspector visited the source, even for only a few minutes. From these interviews, we found that various types of techniques were used, which we grouped into four broad categories: source tests; comprehensive inspections without source tests; routine inspections; and spot checks.

Table One lists the purpose of each type of inspection and indicated the general range of frequencies and effort among our sample agencies for these inspections. As Table One indicates, frequency of testing tends to increase while the level of effort required diminishes. The relationship is a direct one, since shorter inspections have generally been developed expressly for making more frequent inspections at all or some sources. The figures provided on effort are subject to an important caveat. These figures assume that loading activity will be sufficient to conduct the inspection when the inspector arrives. Loading patterns at terminals, and even more so at bulk plants, differ, however (e.g., many trucks may arrive very early in the morning and very late in the evening to load, while few trucks arrive during the middle of the day). Inspectors thus may be obliged to wait at the source until a sufficient number of trucks arrive to observe loading operations and check for leaks at the racks and VRU cycling. Thus, these figures assume optimal scheduling of the inspection visits.

Source tests measure the processing efficiency of the VRU. While several local agencies in our sample have been conducting some type of source test, most of this work has been done by contractors at considerable expense. Several agencies have not conducted any such tests. These test are conducted from at most once a year to every 3-5 years.

Table 1

TYPES OF INSPECTION

Type	Frequency	Approximate Effort
Source Tests	Not More Than Annually	9 Person Days[a]
Comprehensive Inspection	Annual To Every 5 years	4-6 Person Hours
Routine Inspection	1-12 Times/Year	2 Person-Hours
Spot Checks	Variable (Typically Monthly)	15-30 Person-Minutes

[a]Recent efforts to improve the quality of these tests indicate that this figure may significantly underestimate the effort actually required.

Some EPA Regions and state agencies we contacted have also conducted source tests. Frequently, these agencies are able to conduct the tests themselves, but the use of private contractors is not uncommon.

In addition, the methodology to be used for a terminal source test has been quite controversial. Some agencies use the standard EPA recommended method and others employ a variation. The controversy concerns the amount of time, number of people, and equipment necessary to carry out the test. The test typically takes three people several days to set up the test, run it, and disassemble the sampling apparatus. The sample is analyzed on-site in a mobile lab. It usually takes a day to transport the equipment to the site and another day to write up the results. Some agencies have their own source test crews, while others hire contractors to do the tests. One state agency commented that they did not have the staff to do it themselves and no contractor in their area was willing to invest in the test equipment since it would be used only a few times per year. None of the existing source test methods developed so far has met with widespread acceptance.

For inspections other than a source test, the specific procedures employed are similar in many respects. The main variations involve the number of leak points examined and the thoroughness with which other checks are accomplished. To describe these procedures, we first describe a comprehensive inspection in detail, and then outline differences between it an the routine and spot check inspections.

Comprehensive Inspections

Preparation

The inspector begins in the office to obtain information about the terminal, including layout, throughput, type of vapor recovery system, number of loading racks, number of storage tanks, violation history, and new construction. At the terminal, the inspector may begin by reviewing the maintnenance records. However, in many of our sample agencies, a check of the maintenance records was not part of the inspection routine, and some respondents thought that little was gained by reviewing these records. The inspector may then diagram the layout for future reference in checking any new equipment installed. Some inspectors use these diagrams to record the location of leaks or other problems.

Loading Rack

Tank trucks are loaded with gasoline or other fuels at the loading racks. During the inspection, the inspector checks the fuel loading areas for vapor or liquid leads by touch, sight, or sound. Frequently, leaks identified may be confirmed with an explosimeter, a hand-carried device for detecting combustible gas, such as VOCs, by measuring the lower explosive limit of air and vapor forced into it.

If the unit is a top loading rack,[a] each loading arm is inspected for leaks and for nozzle fit into the truck hatch while the truck is being loaded. During top loading, if the nozzle is not seated correctly, leaks are obvious; a fine mist or heavy spray of gasoline can be seen at a distance. Some leaks may not be detected until the inspector climbs up on the truck and runs his hand around where the nozzle fits into the top hatch. These arms are also checked for liquid leaks while disconnected because they have a tendency to drip. Bottom loading areas are checked for proper nozzle connections, and whether the hoses and gaskets are in good condition. The loading area plumbing as well as the tank truck plumbing is checked for vapor and liquid leaks. Work practices at the racks are observed to make sure the vapor control equipment is being used properly (e.g., that vapor return lines are being connected).

The VRU receives the gasoline vapors collected at the loading rack from the tank trucks and storage tanks for processing back into liquid gasoline. In most systems, the vapors are received and stored in a holding tank prior to processing. Within the holding tank is a rubber bladder that expands with the introduction of vapors. On the metal roof of the holding tank are a bladder height gauge and a pressure release valve. When the holding tank is inspected, the height gauge is checked to make sure it is working, the air space between the roof and the top of the bladder is checked with an explosimeter for the presence of VOC vapor, and the pressure release valve is checked to make sure it is not stuck in the open position.

To inspect the VRU itself, the inspector checks to see that the unit is cycling properly, i.e., turning on and off when it is supposed to. The unit is supposed to turn on to process vapor when the holding tank bladder fills to the appropriate level, and to turn off when the bladder is emptied. For units without holding tanks, the units should turn on whenever a truck is being loaded. The pumps, the compressors, and plumbing on the unit are checked for leaks. The inspector checks the gauges on the VRU to see that the operating temperatures and pressures are within the ranges necessary for proper operation (parameter checks). Some special checks can be made on particular units. For example, icing of refrigeration units indicates that the system is operating at too low a temperature.

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[a]In top loading, the trucks are filled through a hatch on the top. A loading arm is swung over the truck and the nozzle is lowered into the open hatch. The vapor return line is attached to this nozzle. In bottom loading, a nozzle on the fuel hose is connected to a fitting on the bottom of the truck. A separate vapor return line is also connected to the truck.

Storage Tank Inspections

Three types of storage tanks are used at bulk terminals. They are fixed roof tanks, external floating roof tanks (with varying configurations of rim seals), and covered floating roof tanks. Inspection of all three types requires climbing them and working on their roofs. Some sample respondents stated that it would take several years for a tank to go out of compliance, and hence frequent inspections were not necessary. In other agencies, tanks are checked once a year.

Fixed roof tanks have a pressure release valve that is checked to ensure it is not stuck open. The top of the tank is checked for holes, cracks, or rusting. Welded joints are checked for holes, cracks, or rusting. Welded joints are checked for leaks with an explosimeter.

Floating roof tanks can be inspected quickly by someone walking the rim of the roof with an explosimeter to check for leaks. Another method is to check the primary seal (which in most cases is a foam-filled rubber rim around the perimeter of the floating roof) for cracks or holes. This requires removing a metallic weather guard covering the seal with spark-proof tools. Metallic shoe type seals have a rubber envelope that can be viewed without removing anything and can be inspected for cracks and holes in place. The rubber seal inspection takes much longer because of the need to remove and then replace the weather guard. Inspections of floating roof tanks typically take 1 hour, assuming that no or few violations are identified.

The covered floating roof inspection requires the same basic technique as the open floating roof. However, the inspectors must wear special breathing apparatus when working in the air space between the fixed and floating roofs. Because of these special requirements, such inspections are seldom performed.

Inspection Reports

Inspection reporting practices vary considerably among agencies. In some agencies, the inspectors prepare reports on the results of all of their inspections. The reports include documentation of violations. Although one local agency we visited did have a formal system of reports for all inspections, the most common practice was for the inspector to maintain a log of daily stops with little or no detail and to prepare a written report only in connection with violations.

Routine Inspections and Spot Checks

Routine inspections were the most widely used technique by local agencies we contacted. Unlike comprehensive inspections not all potential leak points are checked during routine inspections. Although the VRU is similarly examined, frequently only a sample of the loading arms, perhaps three or four, are checked. Storage tanks are generally not included in these inspections. These inspections typically take

about 2-hours to complete. The frequency of these inspections varies among local agencies from once or twice a year up to once a month. Generally, less preparation is needed than for comprehensive inspections.

Many local agencies we contacted also conduct brief spot checks of the terminals. These take place when an inspector happens to be in the vicinity, or plans a stop on the way while traveling between other sources. In these inspections, the inspector checks whether the VRU is operating, and whether it and the loading rack have any gross defects or leaks. The spot checks were considered particularly important in dealing with cases of excessive VRU downtime. These inspections typically take 15 to 30 minutes. Few if any of the preparation procedures are followed and spot checks are at most noted only on the inspector's daily log.

Inspections of bulk plants involve only the loading rack and storage tanks, there being no VRU. Few agencies have yet begun inspecting bulk plants, either because first priority was put on terminals, or else because the local regulations did not yet encompass bulk plants. The frequency of inspections, where they are done, is generally about once a year. The time required for the inspection (excluding tanks) is approximately one hour.

Agency Approaches to Developing Inspection Strategies

Over time, agencies adopt a combination of the inspection types in developing individual inspection strategies. The considerations going into this determination however, vary significantly. Nonetheless, we were able to extract several that seemed to be universally used to a greater or lesser extent by each agency we visited.

The agency's perception of the characteristics of the sources within its jurisdiction, coupled with its attitudes toward VOC enforcement along the gasoline marketing chain (GMC) affected the inspection strategies selected (see Figure 1). To illustrate, an agency that perceived its sources to be essentially operating in bad faith (i.e., having no regard for maintaining compliance) and that placed high or highest priority on VOC/GMC sources would tend to maximize both the frequency and thoroughness (type) of an inspection.

We found that all bulk terminals were inspected at least annually, while some sources in some agencies were visited monthly or even weekly. In between these extremes were nearly as many variations as agencies we contacted. The experience with sources and their individual or group characteristics (frequently stated as whether a given source was "good" or "bad" because of its level of compliance and relations with the control agency) often resulted in differential treatment, with some sources receiving more frequent or perhaps more comprehensive inspections than others.

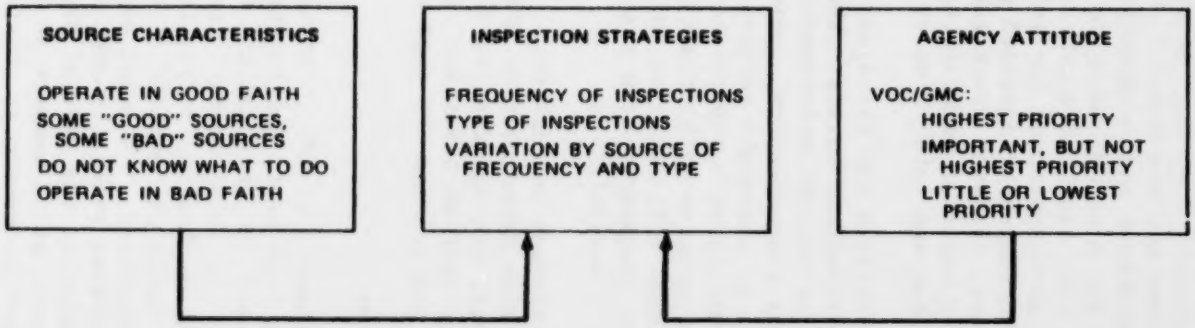

FIGURE 1. FACTORS INFLUENCING THE DESIGN OF INSPECTION STRATEGIES

Most agencies reported that the variables involved in making these determinations were not static. A particular source's characterization as "bad" or "good" might change over time, as might the situation with respect to resources available.

Agencies tend to decrease the overall frequency of routine inspections by giving less attention to those sources found to have fewer problems and a better history of operations and maintenance practices. Thus, quarterly routine inspections are done initially on all sources, but the number of sources receiving this level of attention decreases over time. When the number of routine inspections for selected "good" sources was decreased, however, a continuing or expanded program of spot checks was evident. In these agencies, the spot check was seen as a convenient and relatively inexpensive means of maintaining compliance both by viewing the source's operations and being seen by source staff.

A separate consideration we identified was the agency's responsibility relative to that of other governmental levels. That is, a local agency with primary responsibility for VOC/GMC enforcement would tend to favor more frequent (and perhaps less comprehensive) inspections than either a state agency with secondary or oversight responsibility or an EPA regional office also concerned mainly with supervision and monitoring of other agencies. Thus, state agencies with primary responsibility for enforcement (e.g., through regional offices or in small states with only one agency) inspected much more frequently than state agencies having only (or mainly) oversight responsibilities.

In general, the process of developing an inspection approach or strategy does not consist of a one-time determination that becomes invariable practice over time. In fact, the agencies we visited had changed their inspection approaches numerous times and seemed quite open to modifying them as circumstances changed and the need arose.

Enforcement Techniques and Strategies

Unique approaches to the enforcement of VOC rules for the gasoline marketing chain developed primarily because of the existence of many minor violations and the critical need for good operations and maintenance practices by the sources. In our interviews, we questioned persons responsible for using information obtained during inspections (e.g., the chief of enforcement or sometimes a staff attorney) to decide on whether and how to deal with violations. We asked about the way in which enforcement actions were processed generally and the extent to which available sanctions were applied in the case of the gasoline marketing chain. Finally, we interviewed staff members about informal enforcement tools and mechanisms and the manner in which the available alternatives were assembled for this source category. From this survey we discerned two general types of strategies, adversarial and joint enterprise strategies, which represent different attitudes and approaches to the enforcement problem as well as different collections of formal and informal enforcement techniques.

Adversarial strategies assume that relations with sources will always be adversarial, that sources will not voluntarily comply, and that compliance will be achieved primarily through the activities of the control agency's staff. Adversarial strategies are pursued by deciding ways in which existing inspection and enforcement staff can best compel the compliance of sources. The use and application of sanctions (as opposed to incentives) are emphasized and constant vigilence is seen as the primary vehicle to obtain continuing compliance. Three adversarial strategies were evident among our sample agencies:

- o Identify and notice, but otherwise ignore, minor violations, while maximizing the frequency of inspector presence at the source.
- o Conduct a series of targeted, intense inspections and/or source tests.
- o Initiate one or more major lawsuits or enforcement actions to get the sources' attention.

In contrast, joint enterprise strategies assume that most sources are willing to comply with the rules once promulgated and that the best strategy is to identify or create incentives for the source to comply. Joint enterprise strategies initially require some extensive and creative work by knowledgeable agency staff, but the demands on staff are anticipated to ease as the strategy begins to be successfully implemented. Four joint enterprise strategies were evident in our sample agencies:

- o Provide early and intensive technical assistance to the source through the on-site visits of a qualified engineer.
- o Educate sources on the economic benefit of monitoring the control equipment.
- o Require the development and use of maintenance plans.
- o Use findings from inspections to develop conditions to source operating permits.

Adversarial Strategies

Identify-Notice-Ignore

The first adversarial strategy we identified is to identify and notice, but otherwise ignore, minor violations while maximizing the frequency of inspector presence at the source. Various techniques are used in pursuit of this strategy. In a few agencies, the inspectors simply issue verbal warnings to the source, frequently with the advice that they would return to recheck the problem. Other agencies issue NOVs in such cases with the knowledge that the NOV would probably not result in the initiation of a formal enforcement action. An interme-

diate device has been developed in one agency--the Notice to Comply (NTC). Here, the inspectors are discouraged from the use of verbal warnings, but issuing an NOV has the effect of automatically triggering the formal enforcement mechanisms--a result not always desired. Consequently, the NTC was incorporated into the agency rules. Essentially, the effect of receiving an NTC is to provide the source 2 days in which to correct the violation and another 2 days in which to notify the agency of the corrective measure. Failure to meet this time schedule results in the NTC automatically becoming an NOV without any further action or paperwork by the agency staff.

Among those agencies employing this stratgegy, the choice of specific techniques generally depended on the perception of the role of the inspectors and on the nature of the formal enforcement mechanisms. Verbal warnings were more prevalent where inspector discretion was valued highly and the inspector's personal reputation was deemed sufficient to prompt the taking of corrective action. In addition, verbal warnings were frequently used where problems existed in getting formal enforcement actions processed--either because the enforcement group would not be bothered by such a relatively minor violation or because there was some more systemic problem in processing an enforcement action.[a] NOVs were issued where the agency management preferred to strictly limit the application of inspector discretion and where administrative discretion on whether to process the NOV through the enforcement procedures was encouraged. In these instances, the practice was either to employ a decision rule, (e.g., seek enforcement upon the issuance of three NOVs) or to amass ("bank") the NOVs for use as evidence of a pattern of noncompliance when an enforcement action was finally undertaken. The use of the NTC by one agency reflected a compromise between a disinclination to vest too much discretion in the inspectors and the existence of a fairly mechanical (and inevitable) system for processing NOVs once they were issued.[b] This agency felt that the NTC "rewarded" those sources that were generally in compliance by allowing them to avoid receipt of an NOV for an isolated violation, while involving only a slight delay in securing an NOV against the other sources.[c]

Several agencies, including some employing this strategy, pointed out several problems with it. First, the strategy required constant

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[a]In once case, for example, the state regional office staff had to process enforcement actions through the state headquarters office--a notoriously slow procedure. In another case, the state attorney general was known to delay work on environmental cases.

[b]Typically, the NOVs were processes through a summary criminal citation procedure resulting in relatively small criminal fines.

[c]The efficacy of this approach derives from the relative ease and speed with which many of these minor violations can be corrected by the source.

inspector attention to, and presence at, the source. No matter what specific technique is used, the inspector must return to recheck the source to see if the violation has been corrected. Second, this strategy could tend to lessen the credibility of the agency's "threat of enforcement." That is, where the sources perceive enforcement actions will not or only rarely occur, they can respond to problems identified by the inspectors but otherwise not worry about equipment operation. One agency official expressed concern that his inspectors were becoming little more than the source's maintenance supervisors. This point related to the third and perhaps most important problem: this strategy produces no positive incentives for the source to keep itself in compliance or to change its operation and maintenance practices. Like the speeding motorist, the source understands the chance of getting caught but will continue to violate the rule because only a warning will likely result and even if the source has to pay a fine, the cost is perceived to be less than the costs of keeping itself in compliance. In part to deal with these problems, agencies have employed somewhat more drastic adversarial strategies designed to bolster the credibility of the threat of enforcement.

Targeted Actions

One of these more drastic strategies is the use of targeted source tests or intensive inspections. In any case where work exceeds resources, priorities must be established. Data can come from an analysis of the number of NOVs issued or inspector perception of whether the source is a "troublemaker." Alternatively, priorities may be based on some specific strategy (e.g., concentrating on all the sources owned by a given company). We found that agencies employing this strategy used either a very intense inspection or a source test.

Either of these actions has a variety of effects. Information is generated on the compliance status of the source, which will frequently be sufficient to build a good enforcement case. A few agencies we contacted were empowered to charge the source for the cost of the source test, effectively creating a monetary penalty. In addition, both the intensive inspection and the source test have significant nuisance value to the source. The activities disrupt operations, take up the time of source employees, and may result in adverse publicity. The nuisance effect has been used to advantage by some agencies who believe that sources are inclined to maintain compliance rather than undergo a targeted action. Several officials mentioned that the very threat of a source test being ordered is itself a tool for getting the source to take specific actions to avoid it.

Although the targeted action strategy has several positive aspects particularly when an agency's primary strategy is the inspect-notice-ignore approach, it does create some problems. First, currently available source tests are very expensive to conduct, which is particularly difficult for local agencies not empowered to require the source to pay for it. Second, sources may object to the uneven enforcement,

which may be diffficult to rebut. Finally, the effect of a targeted action may be short-lived, thus requiring the execution of many such actions to keep the source mindful of its responsibilities. This, in turn, taxes resources, which may make it difficult for the typical agency to maintain surveillance of other sources.

Major Lawsuit/Enforcement Action

A third adversarial strategy is related to the targeting strategy but differs in that it makes more direct use of the data generated under the inspect-notice-ignore approach. This strategy is to initiate one or more major lawsuits or enforcement actions to get the attention of all sources in the jurisdiction. Probably the most well-known example of this strategy is the recent lawsuit filed by the California Air Resources Board (CARB) against several bulk gasoline plants and terminals in Southern California. The lawsuit cited approximately 1,000 violations and asked for $7 million in civil penalties and damages.

Perhaps the most common technique used in the strategy is to use a collection of banked NOVs to initiate formal enforcement action. Typically, the basis of the action is that the source has disregarded the rules and has effectively been in continuous noncompliance over the period in question. This technique deals with the problem faced by many agencies of convincing a court, adminstrative hearing board, or even its own legal counsel that the violations involved warrant the time and expense of pursuing formal enforcement proceedings. In addition, a series of NOVs may serve to establish the needed evidentiary basis for prevailing in the enforcement action. This strategy can also be combined with the targeting strategy in deciding where the major enforcement effort can be most productively pursued.

The problems with this strategy are similar to those with the targeting strategy. Where the agency has not banked its NOVs, the grounds for such an action must be a major and intensive inspection action. Local agencies typically do not have the resources to do this alone, and getting support from state and EPA Regional staffs may present nearly insurmountable logistical problems. Also, the inspection blitz technique requires surprise for maximum effectiveness; this alone presents a further problem. The problem of claims of uneven enforcement and the possibility that the benefits will be short-lived are of equal applicability to this strategy.

Joint Enterprise Strategies

Technical Assistance

The first strategy of this type is what we refer to as a technical assistance strategy. This strategy assumes that if the source knew how to stay in compliance and had a reasonable understanding of the workings of the control equipment, it would be self-initiating in maintaining compliance. The prime example of this strategy was found in one

agency we visited, which had an engineer with vast and detailed knowledge and understanding of vapor control equipment. During the implementation and shakedown stages, this engineer spent nearly full time visiting and working with the sources on the solution of technical problems and on ensuring that the prerequisites to proper maintenance of the equipment were present.

One major problem with this type of strategy is that it requires the presence of a highly qualified engineer in the agency. Such persons may be hard to find and even harder to bring on to the typical agency's staff. Even if such a person were employed by an agency, other demands will occur and devoting essentially full time to vapor recovery may be an impossible luxury. Moreover, the sources may not be responsive to this approach.

Economic Benefit

The second joint enterprise strategy is really a variant on the technical assistance theme. We encountered only one real example of this strategy, although a few other agencies were considerating it. The strategy is essentially an effort to educate the sources about the economic benefit of properly maintaining the control equipment. The VRU is unique among pollution control equipment in that its proper operation results in a return to the source of its primary product--liquid gasoline. To the extent that pollution control would be required anyway, a net benefit exists. In addition, the increasing costs of gasoline may result in a situation where the recovered gasoline will not only pay for the initial capital costs of installation and the costs of maintenance, but also return a profit to the source.

The major problem with this strategy is that the necessary proposition--that the VRU is returning a profit--is not confirmed. Some agency staff we interviewed expressed amazement and dismay that companies had not installed flow-meters to measure the amount of recovered gasoline, nor seemed interested in doing so. Without these data, little empirical evaluation of the proposition can be made. We did find that in a few cases, with closely situated terminals sharing a common VRU, a clear economic benefit existed (in fact, in two cases, the terminals had established a formula for allocating the recovered gasoline to the various terminals served). Most often, however, the agencies that had considered this idea had not pursued it vigorously because of the lack of solid evidence and the general difficulty of educating their sources.

Maintenance Plans

The third joint enterprise strategy we identified requires that sources submit and comply with maintenance plans. A maintenance plan generally consists of a description of how the equipment is to operate and what procedures source staff will carry out on a regular basis to assure that it does operate properly. Although only a few agencies in our sample presently require a maintenance plan, several

respondents reported the need for such plans and indicated that they were looking into such a program.

Maintenance plans have typically been imposed as part of an enforcement action taken against a particular source, through an administrative order, consent agreement, or conditions to an operating permit. The special utility of maintenance plans in the context of VOC enforcement along the gasoline marketing chain derives from the leaks and problems with the VRU likely to occur without proper maintenance. In addition, minor violations caused by poor maintenance are not adequate bases for enforcement action.

Several techniques for imposing maintenance plans were reported, although the first action was always to establish agency authority to require maintenance plans. One sample agency analyzed the maintenance records already being kept by the sources to determine the best way to incorporate maintenance plans. Another recommended the use of the agency inspector's checklist as a form for maintenance plan recordkeeping. One respondent suggested three elements to be included in a maintenance plan: a spare parts requirement, a set of performance standards, and a maintenance routine including checklist. The spare parts requirement came from this officials's perception that delays in maintenance sometimes occur because of a lack of attention to ordering necessary parts. In such cases, the existence of spare parts on-site would make immediate repair more likely. The inclusion of performance standards was intended to specify the objectives of the maintenance program as a means of avoiding an overly mechanical implementation of this plan.

Maintenance plans were generally seen as a useful adjunct to enforcement, although some concern was expressed about the agency's authority to require them, and about whether they should be required of all sources. Some agency staff noted that maintenance plans added to the number of items requiring inspection. Perhaps the most common problem stated was the lack of assurance that the sources would actually do the maintenance, versus just routinely filling out the forms. Several inspectors indicated to us that, with experience, an inspector could readily determine whether the maintenance was being done. To the extent that this is true, misrepresenting adherence to the maintenance plan would likely serve as an independent basis for issuance of an NOV.

Permit Conditions

The fourth joint enterprise strategy involves attaching conditions to source operating permits. Most agencies we contacted had some system of issuing operating permits for sources within their jurisdiction, although few used the device of attaching conditions except in the context of an enforcement action (e.g., permit revocation, abatement order). The advantage of this strategy most commonly reported was that specific problems peculiar to a source could be treated without amending the agency's regulations.

To accomplish this strategy, the agency must first generate information to determine what conditions should be applied. Several techniques for achieving this were reported, the most common being an analysis of the results of regular inspections. Any patterns to problems can be identified and used for this purpose. One agency had further refined this technique: major inspections were scheduled to coincide with the expiration of the source's annual operating permit. This technique provided very current data on the condition and compliance status of the source and could be fed immediately into the consideration of an appropriate condition to be added to the renewed permit. In general, agency respondents suggested that, if conditions are used, they should be as specific as possible to maximize their usefulness.

Many of the same problems discussed with respect to maintenance plans are applicable to the use of permit conditions. The respondents agreed, however, that the imposition of conditions put the source on notice that it was being scrutinized and would provide a specific basis for more drastic action (e.g., revocation of the permit for violation of the conditions) should further problems with the source be experienced.

IV REMAINING PROBLEMS IN UNDERTAKING COMPLIANCE ACTIVITIES

Even for those agencies highly experienced in enforcing VOC rules for the gasoline marketing chain, numerous problems exist that inhibit fuller realization of regulatory goals. These problems involve the effectiveness of the control equipment, the need for acceptable operations and maintenance practices, the difficulties in processing minor violations, and some issues involving agency recordkeeping. Each of these problems is discussed in this chapter. In addition, we have presented specific suggestions from our respondents for dealing with or addressing them.

Control Effectiveness

Even where required equipment has been installed at a source, the effectiveness of those controls was questioned not only by some respondents but also in the literature.[a] Problems include VRU downtime, belching, switch-loading, and top loading. Belching is the release of vapors from the bladder pressure relief valve into the atmosphere and occurs when the capacity of the processing unit and vapor holding tank bladder is exceeded. Switch-loading is the loading of diesel or fuel oil into trucks that have previously collected gasoline vapor without collecting the vapor thereby displaced. Top loading refers to one type of hook-ups used by tank trucks.

We encountered significant controversy in the field over whether and to what extent these conditions and practices represent important emission problems. Some agency personnel believe they represent relatively few emissions and are not worth significant special attention. Others (frequently higher level agencies that conduct periodic comprehensive inspections for monitoring purposes, such as EPA regional offices and active state agencies) believe that both individually and (more certainly) collectively these problems represent major emission problems.

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[a]See, "Investigation of the Compliance of Vapor Recovery Equipment at Gasoline Bulk Terminals in the South Coast Air Quality Management District and Kern County Air Pollution Control District," California Air Resources Board (November 1978).

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Downtime of the Vapor Recovery Unit

The most critical uncertainty is the amount of downtime of the VRUs (i.e., periods when the VRU is not operating and collected vapors are simply vented). Opinions vary widely on this issue, from that of one state official who estimated that the systems are down as much as they are operating, to that of a highly experienced local inspector in a different state, responsible for several terminals, who stated that the VRUs experienced very little downtime.

The only hard data we obtained on this question were for a single terminal in one jurisdiction where the VRU had been operating 80% of the time. While 20% downtime does not seem too excessive at first glance, the uncontrolled emissions from such terminals would be nearly three times as great as that allowed by regulation.[a]

The effectiveness of the VRUs when they are operating appears to be satisfactory. The source test results that we have seen generally show a processing efficiency of more than 90%. However, even a 20% downtime would imply an urgent need for technical repairs or design changes in the vapor recovery equipment, and/or heavy emphasis on enforcing a higher standard of maintenance on these units.

If VRUs do have excessive downtime, inadequate maintenance is cited as a major cause (see below). Another reason given by some agencies is long delays in obtaining spare parts. Finally, several officials thought that unreliability of particular units was an important contributing factor.

Some agency staff we interviewed identified differences in the amount of downtime and difficulty of maintenance of various types of equipment available. On this basis, a suggestion was made to issue a list of approved equipment. Although the potential negative consequences probably argue against issuing such a list, such information could aid new agencies to the extent that informal education and pressure on the source could result in more effective and trouble-free equipment being installed. Moreover, several instances of improper sizing of vapor recovery equipment were identified in our interviews. Better information on appropriate sizing relative to throughput and the specific design of the source would be of great benefit to agencies previously inexperienced in this area.

The most commonly heard suggestion to correct the VRU downtime problem was to install some type of continuous monitoring device. The simplest and least expensive type would just provide a record of whether and when the VRU was running. To the extent that downtime does

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[a]Emission reduction = 80% operating time x 90% efficiency = 72%. Emissions = 100% - 72% = 28% of the uncontrolled emissions, compared with 100% - 90% = 10% allowed.

represent a major problem with this control equipment, such informaton could have great utility for enforcement agencies. More sophisticated versions could also provide constant parameter checks (e.g., pressure and temperature) that would provide a basis for assessing the efficiency of the recovery unit. The practical and legal hurdles to creation of a continuous monitoring requirement have been discussed extensively both within EPA and elsewhere. Resolution of the downtime question would probably provide the best guide to the relative necessity of developing such requirements for VRUs at bulk terminals.

Belching

The belching problem is a potentially significant cause of excessive emissions. One state agency calculated the emission from belching to be nearly as large as the 10% allowed by regulations (at 90% efficiency). An extensive belching problem would indicate than many VRUs do not have sufficient capacity for the loading rate and pattern of the facility. While several agencies were concerned about this problem, many others were generally unaware of it.

Belching is also related to problems of improper sizing. For systems without a vapor holding tank, the problem is apparently soluble by limiting the capacity of the loading pumps to the capacity of the VRU. For systems with vapor holding tanks, an automatic switch can be installed that prevents loading when the capacity of the holding tank is reached.

Switch-Loading

Switch-loading may be the third most significant source of unallowed emissions. Calculations by a state agency indicated that total emissions at the loading rack might be about half the 10% allowed to be released from the VRU (with an uncertainty in that estimate of a factor or two). Switch-loading was, however, estimated to account for approximately two-thirds of the loading rack emissions.

In some cases, the problem of switch-loading arises because of the absence of a vapor collection line on the loading arms for diesel or fuel oil. A member of the SRI project team observed one case where a truck, previously loaded with gasoline, loaded diesel fuel from a top-loading arm that did not have a vapor return line. If this were a common equipment problem, recovery of the vapors from switch-loading could be accomplished by adding a vapor recovery line to the racks used to load uncontrolled fuels.

Top Loading

We found general agreement that top loading of the tank trucks is a particular problem. Top loading results in several times more leakage than bottom loading. With top loading, damage to the truck dome-hatch sealing surface from the nozzle occurs so often that it seems unlikely

that a satisfactorily low level of leakage can be attained with any reasonable level of maintenance or enforcement. One respondent stated that a fully certified truck could be in violation after one top loading operation because of this effect. In addition, with top loading there appears to be no good method of preventing gasoline from dripping out of the nozzle after it is removed from the truck. We were told that the industry trend is toward bottom loading. Rules requiring at least the phasing-in of bottom loading would be useful.

Operations and Maintenance

Unlike several other areas of environmental regulations, we found that getting control equipment initially installed was considered a relatively simple task. Although significant controversies were reported at the rulemaking stage, most companies moved quickly to install equipment once the rules were set. Quite the contrary was reported with respect to operation and maintenance (O&M).

O&M problems were reported to be pervasive and to present significant enforcement problems for the agencies sampled. While O&M is generally recognized as a significant "second generation" environmental protection problem in most areas of pollution control, it seems especially problematic for VOC and the gasoline marketing chain, which relies on the capture of all vapors and the recovery of 90%. Both leakage and recovery efficiency less than 90% result in emissions significantly greater than contemplated in the control strategies. Thus, progress toward achieving the overall emission limitation is dramatically hampered by poorly maintained equipment.

Because such reliance on O&M is a relatively new experience for enforcement agencies, effective strategies are not yet well developed. Improper O&M is identified mainly through analysis of patterns of small-scale violations, any one of which is generally an insufficient basis for a significant enforcement action. Once the pattern is identified, mechanisms frequently do not exist for addressing the basic problem--inadequate O&M. Strategies aimed at enforcement actions on the basis of a collection of small-scale violations, while having potentially valuable future effect, can do little or nothing about the excess emissions already released. Traditional enforcement approaches seemed to be too little and too late, or else too excessive to be reasonably applied. New approaches are clearly and quickly needed.

All agencies agreed that sources must take responsibility for adequate O&M. Some rules have specified provisions requiring equipment to be in "good repair" or "in good working order." A citation for disrepair or inadequate working order implies the lack of O&M and can serve as the basis for requiring the source to take specific measures to improve O&M. Similarly, a record of leakage or of vapor loss can serve as the basis for requiring O&M measures.

In the context of an enforcement order, the source may be required to submit maintenance plans and schedules and to keep records of maintenance performed. One respondent suggested including three elements in such plans: a statement of the maintenance or performance standards to be met, a description of the O&M techniques to be used, and an assurance that specified spare parts will be kept available on-site. Whether all or only some sources should be subject to O&M plan requirements has been somewhat controversial. This becomes an enforcement strategy issue to the extent that a source's self-initiated good maintenance relieves it of the recordkeeping and reporting burdens and thus provides an incentive to do proper maintenance.

Outside of the context of an enforcement order, sources may be required to prepare and submit O&M plans and the like as assurances of compliance with a good repair/good working order rule or they may be made a condition of the operating permit. We found, in fact, that conditions to operating permits are a very important technique in this area and should be seriously considered by agencies beginning implementation of new VOC rules.

Handling Minor Violations

Several respondents noted the problems associated with attempting to commence enforcement actions on a minor violation such as a leak at a single emission point. In some cases, agencies established methods to quantify the leak on the assumption that, if a quantitative basis for the action existed, the chances for an effective remedy were strengthened. (One rule, for example, establishes a violating leak at 0.6 lower explosive limit with the explosimeter 2 cm from the leak point for 10 seconds, and a liquid leak at more than 3 drops per minute per leak point). Some other agencies believed that such quantifiable standards simply opened up the opportunity for the source to contest the standard and the measurement and thus opted for a flat no-leak, vapor-tight rule. In both cases, the problem of commencing enforcement actions of leaks remains.

A different approach is to consider leakage or a pattern of identified leaks over time to be indicative of the lack of proper O&M. In such cases, O&M requirements can serve as the basis for requiring action by sources. If this approach is taken, quantifying leaks then appears to be less necessary because the focus of the inquiry is the reason for the excess leakage, i.e., the cause rather than the effect. On the other hand, if enforcement is to be commenced on the basis of a given leak, some measurement of the leak would be useful in making the case for applying sanctions on that basis alone. It appears that the choice of approaches to minor violations (quantitative standard or flat prohibition) may relate heavily to the particular inspection and enforcement strategies employed. For example, an inspection program heavily oriented toward spot checks supplemented by routine inspections would likely be facilitated by a flat standard. Similarly, an enforcement

approach based on the banking of NOVs or the requiring of maintenance plans would be facilitated by a rule that provided the means to cite all instances of leaks identified--again favoring the flat prohibition type of rule.

A major locus of minor violations are the tank trucks that deliver gasoline from terminals to either bulk plants or final outlets. Most respondents agree that a program of periodic inspection and certification of tank trucks should be established. If inspection of trucks is limited to times when they happen to be at the loading racks while a terminal or bulk plant is being inspected, many will escape inspection for long periods of time. In addition, inspections of trucks at the rack are less effective than pressure tests of the trucks such as recommended in the Control Technique Guidelines (CTGs) for tank trucks.[a]

Detection of the minor leaks is in itself a significant problem. Traditionally, inspectors have employed the "see, feel, hear, smell" method of detecting leaks, which relies solely on the inspector's senses. Recently, however, explosimeters have come into wide use among agencies with VOC rules to enforce.

Although we found unevenness in their use, the agencies we visited were in favor of the regular use of explosimeters. As noted above, one agency used a quantitative leak standard employing the device, but the more common practice was its use to verify the existence of VOC vapors to establish that a leak of unspecified size was occurring. Explosimeters supplement the traditional method of finding vapor leaks and their use should be encouraged.

Recordkeeping

We found the records now being kept by agencies to be far too limited to provide a basis for close, particularly quantitative, analysis of staff utilization. Records are generally limited to data that track progress in compliance schedules that must be submitted to EPA for the Compliance Data System. We had hoped to obtain records of the number of inspections by source, specifics on what was inspected, time spent on each inspection, and what was found. Existing summary records generally record only the date on which a formal annual inspection was conducted or the issuance of an NOV. Much of the needed data are recorded in the inspectors' logs but are not compiled or summarized in central records. While data do exist on formal enforcement actions, they provide little insight on the extent to which other, especially

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[a]Environmental Protection Agency, "Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems," EPA-450/1-78-051 (December 1978).

informal, enforcement strategies are occurring nor on their effectiveness. Without such data, we could only report opinions as to the frequency of various types of inspections, the effect of the inspections on improving maintenance and operating practices, and the relative performance of different kinds of inspectors.

V THE DEVELOPMENT OF COMPLIANCE STRATEGIES: CONCLUSIONS FROM THE SURVEY

As a result of our study of the organization, staffing, and inspection and enforcement activities of experienced agencies, we reached several major conclusions that we believe should be given serious attention by any agency in the process of developing compliance strategies for VOC regulations. Although these conclusions relate most directly to the gasoline marketing chain, many of the concepts are also applicable to other VOC sources.

Developing Compliance Strategies

A compliance strategy is based on the relationship between several factors as determined by applicable regulations, the staff and organization of the agency, and the control and inspection tools available for achieving compliance. Developing a compliance strategy does not involve the adoption of one ideal design nor even a choice from a set of packaged models. Rather, agencies should commence a process of relating the conditions and characteristics of VOC in their jurisdiction, the source category, and the agency itself toward the development of individually satisfying and appropriate strategies. Figure 2 illustrates this process.

The elements of this process are both interactive and individually relevant to building the compliance strategy. Although placement within the intergovernmental system is essentially mandated, this factor has important implications for both inspection and enforcement techniques available (see Chapter III). Agency priorities are, of course, highly changeable, except to the extent that air quality and emissions data, legal requirements, and the type of sources within the jurisdiction set priorities for them. At the time of implementation, new rules will affect existing priorities in different ways, depending on the agency. So that new priorities are set in the most useful way, agencies need to understand the nature and extent of available resources, the demands that are created by both existing and new rules, and how each piece fits into the overall effort to achieve the ambient standard.

Other significant factors are agency and staff types, source characteristics, and effective control technologies. Agencies should endeavor to examine whether they are more like one or another of the types we have described and whether that is both desirable and consistent with local objectives and capabilities. These determinations have a role in understanding the nature of existing capabilities and needs for capacity building. Of the four agency types suggested in Chapter III (Commando,

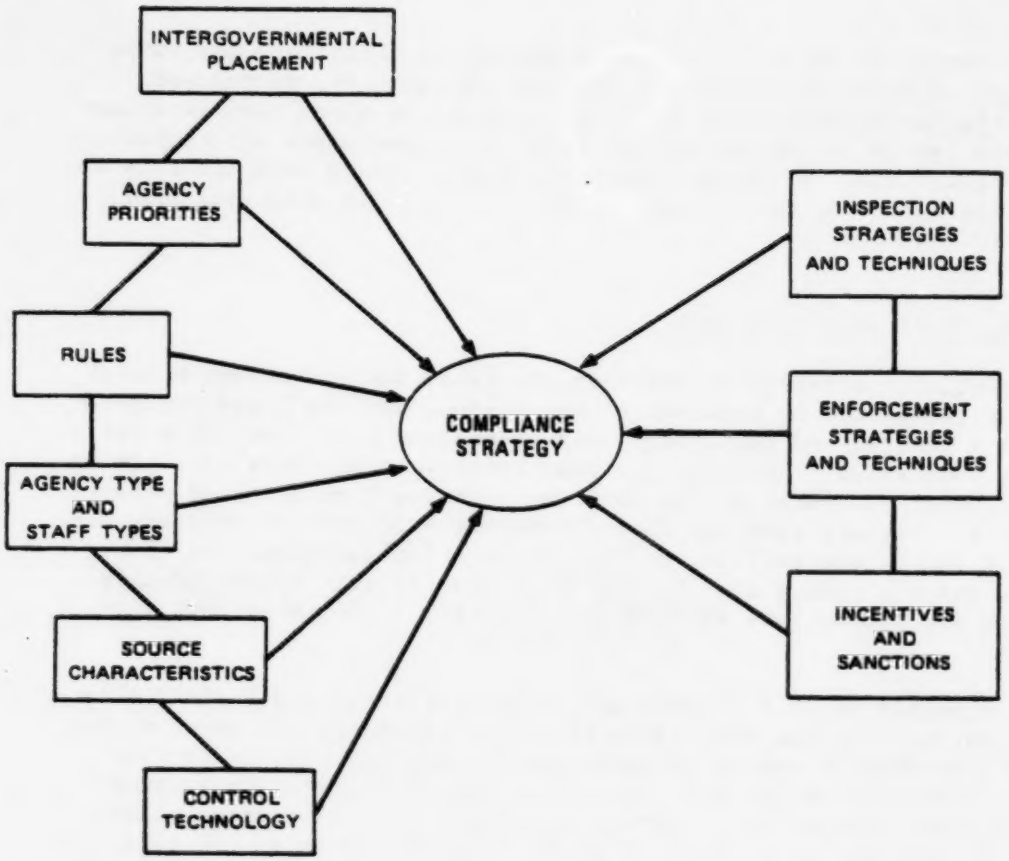

FIGURE 2. COMPLIANCE STRATEGY DEVELOPMENT

Beat Cop, Technical Assistance, Utopia), one may be most familiar or desirable. Moreover, existing and available staff may conform to one agency type. A thorough knowledge of the source characteristics relevant to compliance as well as the nature of and problems with the control technology (see Chapter IV) are also important to developing an effective compliance strategy. Knowledge of these factors is then used to decide among the array of inspection and en- forcement techniques, the formal and informal incentives and sanctions, in the development of a compliance strategy.

This strategy incorporates all that is known (and desired) about implementing new rules and should begin to make the task seem more manageable. Our sample agencies went through similar processes over many years, although perhaps not consciously, to arrive at existing strategies that continue to undergo change. Agencies about to implement VOC rules may be able to shorten this development time drastically by consciously following a development process, one of which is suggested here.

Assembling Compliance Techniques

A major finding from our study was that in enforcing VOC regulations for the gasoline marketing chain, informal or nontraditional means of achieving compliance are as important if not more so than formal ones. Different combinations of enforcement techniques are appropriate, depending on such factors as agency type and style, staff available, and source characteristics.

Typically, enforcement is thought of only as an interaction between an agency and a source through the application of formal sanctions. However, our analyses of formal sanctions and their use show that they form only a small portion of existing enforcement activities. A more complete view is depicted in Figure 3. Strategies involve various mixes of formal and informal sanctions, as well as natural and artificial incentives. Because this phenomenon became apparent very early in our interviews, much of our discussion with agency staff dealt with identifying which of the various approaches were used. Examples of available tools are shown in Table 2.

Formal sanctions are generally well understood and include such methods as fines and orders. Informal sanctions are any means of causing the source some discomfort as a result of its noncompliance. Natural incentives tend to make the source want to comply because of some self-interest. Artificial incentives, on the other hand, involve the imposition of some burden, generally by the agency, that can only be relieved through the source's general compliance or its taking specified actions.

In the application of incentives and sanctions, the distinctions among them will tend to become blurred. For example, the burden of

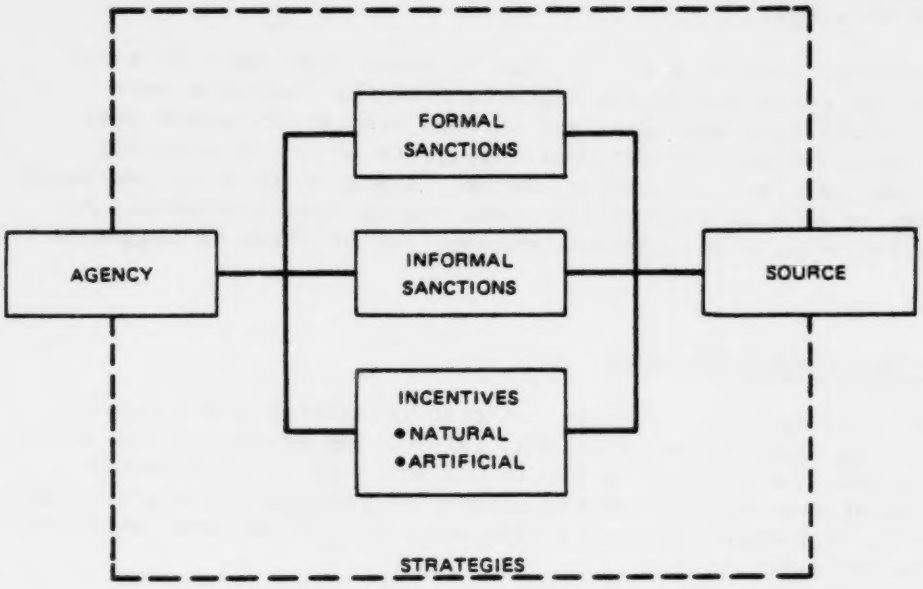

FIGURE 3. TYPES OF INTERACTIONS BETWEEN AGENCIES AND SOURCES

Table 2

INCENTIVES AND SANCTIONS

- o Formal Sanctions
  - Fines
  - Injunctions
  - Orders
- o Informal Sanctions
  - "Hassle"
    - Reporting requirements
    - Increased inspections
  - Adverse publicity
- o Natural Incentives
  - Good public image
  - Safety
  - Gasoline recovery
- o Artificial Incentives
  - Relief from reporting and paperwork burden
  - Self-enforcement
  - Other permit approvals

paperwork requirements can be an effective, informal sanction. If a means exists to relieve the extent of paperwork requirements, however, the agency has effectively created an artificial incentive. These tools can be highly useful with such compliance problems as inadequate operations and maintenance. Safety considerations can be used productively as well. For example, liquid leaks present important safety problems, in addition to producing emissions.

Under this conception of enforcement tools, the inspection function becomes more than a surveillance and apprehension device. The timing, frequency, and extensiveness of inspections may be considered another enforcement tool. "Good" sources can be rewarded by having fewer inspections, while "bad" sources are subjected to greater scrutiny. Such a technique creates both an informal sanction (burden) and an artificial incentive (relief from the burden for moving to the "good" column). For this reason, agency considerations about the optimal mix of inspections should assume that sources will be treated differently, depending on their willingness to comply.

Other examples of mixes of these tools could be given. What is important, however, is the need for a varied view of enforcement in the VOC area because of its special circumstances: many sources, numerous minor violations, and the apparent inappropriateness of using formal sanctions alone. Where such an approach is adopted, the enforcement activities tend to be less targeted to maximizing fines collected and more to creating an environment within which compliance will be maximized. One challenge of implementing the VOC rules for agencies will be attempting to understand this somewhat broader view of enforcement and consciously applying it to agency activities.

The agency's particular compliance strategy will both determine and be determined by the most appropriate mix of these enforcement techniques. Not all will be appropriate to a given agency's circumstances, and different techniques may be more or less important over time and among sources. The various elements of a compliance strategy as depicted in Figure 2 should be coordinated in selecting techniques. Table 3 shows examples of such combinations for each of the four agency types we identified.[a] Both adversarial and joint enterprise strategies are used. Note that one technique can build upon another in implementing the overall compliance strategy.

Of primary importance in assembling compliance techniques is that they be appropriate to agency priorities and consistent with organizational and staff realities. If any component is missing or lacking, the agency should seek assistance in training or perhaps increase the level of resources available.

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[a]Further examples drawn from representative agencies appear in Appendix A.

Table 3

EXAMPLES OF ASSEMBLING COMPLIANCE TECHNIQUES

COMMANDO AGENCY

Staff: One expert inspector with other responsibilities

Agency Priority: Important, but not highest priority

Techniques:

- Get state/EPA help to do targeted inspections and source tests
- Use information from targeted actions to develop specific permit conditions
- Vary type and number of inspections by source history, relying heavily on spot checks

BEAT COP AGENCY

Staff: One or more expert inspectors assigned to geographical areas with responsibility for most sources in their areas

Agency Priority: Important, but not highest priority

Techniques:

- Establish even mix of inspection types; begin with more emphasis on routine inspections; rely more heavily on spot checks as "good" sources are identified
- Inform sources that they can be relieved of inspector presence with good O&M
- Require maintenance plans and use elements for inspection checklists

TECHNICAL ASSISTANCE AGENCY

Staff: One highly qualified engineer

Agency Priority: Among highest priorities

Techniques:

- Embark on a program of site-specific technical assistance as installation activities begin
- Generate information for use in development of maintenance plans and specific inspection checklist
- Orient other staff to phase-in routine and spot check inspections

UTOPIA AGENCY

Staff: Engineer and expert inspectors devoted to VOC activities

Agency Priority: Highest priority

Techniques:

- Commence a range of activities including various inspection routines and site-specific technical assistance
- Assemble results of inspection data to develop maintenance plans or permit conditions
- Conduct inspection blitz to increase visibility of compliance activities

Stages of Implementation

Our survey suggests that certain stages of implementation require differing approaches and emphases. These stages include those commonly recognized, such as rulemaking, compliance scheduling, and equipment installation, but also include fairly distinct stages following installation. This latter group includes an equipment shakedown period, an early continuing compliance phase, and a later continuing compliance phase.

Typically, agencies are more or less active during the initial compliance phase of new regulations (i.e., before or during the installation of control equipment), depending on the relative recalcitrance of sources to install equipment or otherwise commence compliance. Our sample agencies found that significant controversy occurs during the rulemaking phase, followed by much less difficulty in getting equipment installed once the rules are finalized. Most of this experience, however, was with gasoline terminals, a large percentage of which are owned by large companies. More difficulties with installation of equipment may be experienced with the smaller, independently owned bulk plants, and perhaps even more so with independent truckers. Even where initial compliance activities go smoothly, however, the newness of the control approaches and the large number of sources argue for an agency giving special consideration to activities during initial compliance that have special utility in the VOC area.

Initial Source Contacts

Both because of the interactiveness of the control systems and the large number of sources, comprehensive initial contacts with sources are particularly important in the gasoline marketing chain. The control system breaks down completely if any link in the chain (trucks, plants, or terminals) is not equipped to control, transfer, or process the vapors generated. Because a large portion of the facilities are owned by major oil companies, a few agencies underscored the usefulness of notifying upper corporate management of the onset of the rules. In this way, the corporate information system is used to spread the information about implementation and a large number of sources are affected. In addition, paying special attention to the major companies has broader effects. Where a terminal installs control equipment, for example, local rules may be written to prohibit it from loading trucks not equipped with vapor line hook-ups.

Simply identifying sources subject to the regulation is a nontrivial task, particularly when the Agency begins focusing on bulk plants and trucks as well as bulk terminals. Initial source contacts, as well as the production of a list of sources, may be facilitated by the use of state agencies or EPA regional offices. These agencies may make contacts with the major corporations in their area, generate preliminary lists and make initial corporate-level contacts to accomplish some of the ground work for local agencies. Another possible resource are the

trade associations. Generally, there has been reticence on the part of associations to supply membership lists to agencies since their members will be more quickly identified than will nonmembers. However, associations may be much more willing to do mailings themselves, particularly if the information is in the nature of giving members an advance look on what the control agency will be doing to enforce the rules. Finally, liaison with control equipment manufac- turers and sales representatives has been suggested as a useful ap- proach. The agency and the equipment manufacturer will share an interest in identifying sources subject to the regulation and getting the equipment installed.

Workshops to Inform Companies of Rules and Policies

Although the use of some means other than formal publishing to inform sources of new rules is not a new idea, it is particularly important in this area. Workshops can stress that good O&M is the key to complying with the rules and to maintaining good relations with the agency. More generally, such meetings take on great importance to the extent that the industry is well organized and coordinated. Numerous examples exist of an apparently organized effort to undermine rules by firms raising first one issue and then another and the agency responding with piecemeal and thus frequently inconsistent advice. The sources should be brought together and given a complete understanding of how the agency will interpret and enforce the rules. Special problems or complaints can be aired at that time and answered in the presence of all. What this means for the agency, of course, is that it spends time (perhaps in conjunction with other agencies in the general area) discussing issues and settling on uniform interpretations and policies. Only in this way can the effectiveness of such meetings be maximized.

Increments of Progress

Progress schedules are particularly relevant in the VOC area, given the large number of sources and the experience of some agencies that control equipment is frequently hard to acquire on time. Only a limited number of suppliers are available and within a local agency's geographical area the number of qualified installers are likely to be even more limited. In calculating appropriate compliance schedules, realistic assessments should be made of the time required to produce a source list (as indicated above, this can be highly time consuming), negotiate with sources, allow time for delivery problems that may be occasioned by supplies of control equipment relative to the demand, and provide for installation and shakedown problems which are likely to arise. Agency staff should be very familiar with the realities of getting equipment installed and be able to determine when sources are asking for more time than necessary or are being unrealistically optimistic. Negotiations can be preceded by the mailing of detailed fact sheets and perhaps a request for a proposed compliance schedule from the sources.

Plan Reviews and Equipment Installation Inspections

One sample agency conducted a program consisting of reviewing its sources' plans for installing control equipment and conducting on-site

inspections of the installation process. In this way, the agency could make any useful design changes, such as facilitating access to inspection points before actual construction, and more easily understand how the source was set up. One interesting technique was to monitor the installation and tuning of the VRU to obtain data on standard operating parameters. The parameter data were recorded and maintained for later use in facilitating and improving inspections of the operating efficiency of the VRUs.

Somewhat less ambitious but also highly useful was another agency's practice of sending out questionnaires soliciting information for use in designing inspection procedures and strategies. Examples of useful information include the brand of control equipment being installed (slightly different inspection techniques exist for different units), and the source's loading patterns so that inspections could be scheduled for peak loading times.

Multiplying Effectiveness

Even assuming an agency's adoption of all the appropriate techniques and the devising of an optimal compliance strategy, the resources required may still exceed those available. Where rules for new VOC sources beyond the gasoline marketing chain must also be implemented, resource limitations are almost certain to exist. Thus, agencies should carefully consider ways in which they can multiply their own effectiveness by using other agencies. Candidates for such coordination are those with different regulatory interest in the sources or those that employ a field staff that spends some time on-site at the sources. In general, two kinds of agencies might be used: pollution control agencies at other levels of government and agencies not directly involved in pollution control.

Intergovernmental Roles Among Pollution Control Agencies

More cooperation and coordination among local, state, and regional agencies in the use of staff is highly important. State or EPA agencies may be the most appropriate locus of staff and resources to conduct source tests in this area, given the time and expense required as well as the need to maximize inspection time at the local level. In addition, some means of relating what is done by EPA regional or state inspectors to the normal inspection schedules of the local agency is needed. Such coordination could produce better supervision of sources as well as augment the number of inspectors present. Staff and resource sharing should be employed wherever possible. In general, the size of the problem requires that any unnecessary duplication be eliminated and that what resources are available be employed in highly efficient ways.

Use of Agencies Not Directly Involved in Pollution Control

We identified several instances where air pollution control agencies had found ways of employing the resources of other agencies with

related interests or regulatory objectives. Such strategies as the following are highly promising and should be pursued seriously by control districts:

- Truck certification: The department of transportation or state fire marshal is also interested in truck regulation; the fire marshal in one state now includes vapor tightness checks in his general safety inspection and certification program.

- Initial implementation problems: In cases where the agency desires to effect some design change or to enforce adherence to a milestone in a compliance schedule, the building inspector is a possible resource. Building inspectors can generally shut down work much more readily than can control agencies. Consequently, informing these staffs of likely problems to be encountered and enlisting their aid can be highly useful.

- Use of the OSHA mechanisms and inspection capability: OSHA concerns, while differently based, frequently include similar issues. For example, the flammability of gasoline makes leakage an OSHA concern as well as a pollution concern. OSHA powers may be productively employed both for particular problems and for maintenance problems generally.

- Other possibilities: Another agency responsible for inspecting the sulfur content of oil may have an inspector who might be used. Business licensing agencies, oil and gas taxation offices and the like, have records useful for identifying sources.

If agencies about to implement (or extend) their VOC rules are to have an effective program, they will have to use any and all resources available. This includes agencies not traditionally associated with air pollution control but that have some interest in the source or some reason to have personnel on site. These resources should be put to maximum use by the air pollution control agency.

Planning for New VOC Sources

This study has been limited to one component of the larger set of VOC pollution sources--the wholesale gasoline marketing chain. In so limiting it, we have both responded to an immediate enforcement need and provided some information needed by agencies as they begin to think about the larger question of VOC enforcement. When agencies consider the problems associated with service stations, cutback asphalt, dry cleaners, painting and coating operations, and the numerous other sources, the problems and issues alluded to and discussed in this report will only multiply. Because these sources share the attributes of

invisible emissions, relatively new control technologies, and a multiplicity of sources, we believe that many of the ideas generated by our interviews with regional EPA, state, and local agency staff members will be useful as agencies plan for new VOC sources.

APPENDIX A

CASE STUDIES OF AGENCIES EXPERIENCED IN VOC COMPLIANCE ACTIVITIES

DISTRICT A

Background

Air pollution regulations requiring vapor control on bulk gasoline terminals and plants have been in effect since 1970. At present, this agency's jurisdiction includes 19 bulk terminals and 45 bulk plants.

The enforcement agency in this district defines a bulk terminal as a facility that dispenses more than 20,000 gallons per day for 300 days per year (6 million gallons per year). All facilities meeting this definition, in addition to meeting vapor control requirements, must obtain a permit prior to installation or expansion of any potential air pollution source. To ensure that the facility is operating within the design specifications approved by the district engineer, an operating permit is also required.

Agency Organization

The local agency has primary enforcement responsibilities for a region encompassing several counties; it relies on the state agency for technical guidance and some funding.

Headed by the Air Pollution Control Officer, the agency is made up of the following six divisions:

- The engineering division operates the permit system, performs evaluative services, prepares the source inventory, and handles special technical projects.
- The technical services division includes the laboratory, source test, meteorology, air monitoring, research and planning, and a technical library.
- The enforcement division is made up of four sections: (1) central operations, which provides internal administration; (2) inspection section, which keeps stationary sources under surveillance; (3) field engineering; and (4) vehicle inspection.
- Legal counsel.
- Administration.
- Public information.

The air pollution inspectors are assigned to the enforcement division. The agency has nine senior inspectors, with six inspectors assigned

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to each senior. Inspectors must have 2 years of college-level formal education in one of the sciences and attend class for 3 months prior to a field assignment. When a field assignment is given, the new inspector works with an experienced inspector until he or she is ready to go into the field alone. These inspectors are assigned geographically and are responsible for monitoring all stationary sources within their territory. They are also responsible for maintaining liaison with industrial representatives and local health and fire officials.

Field engineers, who are also assigned to the enforcement division, support the inspectors by supplying technical information and by following up on specific problems detected by the inspectors. They also examine control equipment to determine whether it will bring violating sources into compliance. The field engineers are usually assigned to a specific technology or type of point source.

Inspection

Overview

The agency conducts three types of inspections: source tests, routine inspections, and spot checks. The source tests measure the efficiency of the vapor recovery units (VRUs). In the routine inspections, the inspectors check the operation of the VRUs (without measuring efficiency) and check for leaks at the loading rack. Spot checks are brief visits made when the inspector happens to be in the vicinity of the facility.

Source Testing

Because bulk plants are not required to install vapor recovery units, comprehensive source testing is required only for bulk terminals.

The source test now used by this agency is a continuous test, requiring from the morning of one day until noon of the next day to complete. Three people are needed to complete a source test--two people during the day and one to monitor the equipment overnight. The test samples vapor recovery by weight of vapor recovered per 1,000 gallons of throughput. By monitoring the amount and temperature of vapor recovered, the weight can be calculated.

Because of the lack of manpower and the nature of the equipment, the agency believes that one source test per week per team for a bulk terminal is reasonable. At present, it has only one three-person source-test team.

Routine Inspections

Bulk Terminals

The routine inspection concentrates less on the vapor recovery system and more on the other control equipment required for a bulk terminal. One

of the primary functions of this inspection is to determine whether a terminal requires closer scrutiny by a field engineer. The inspection normally takes one inspector 2 to 3 hours to complete. An experienced inspector can complete two terminal inspections per day. The only equipment needed to conduct a routine inspection is an explosimeter.

On top-loading racks the inspector checks each loading arm for leaks at the joints and at the nozzle during operation. It usually takes 3 to 4 minutes per arm if no leaks are found. A top-loading rack could have as many as 20 arms and take an hour to inspect. For bottom-loading racks, the inspector will check each nozzle to be sure that the "O" ring is in good condition and that it does not leak while connected to a truck. The time needed to check loading racks depends on the amount of use they are getting.

The gauge on the vapor holding tank is checked to make sure it is operating, and the pressure-relief valve and air vents at the top of the tank are checked for vapor leaks. If the air vent on top of the tank shows evidence of hydrocarbon vapors, the collapsible vapor bladder inside could be leaking. This test takes less than a half hour. The vapor recovery unit is checked for liquid and vapor leaks around the pump shafts, compression valves, and fittings. This inspection takes 5 to 10 minutes to complete.

Storage Tanks

Storage tanks are not always checked during a routine inspection. When tanks are inspected, only those with a capacity of more than 40,000 gallons are checked. Floating-roof storage tanks must meet equipment specifications and compliance requirements that reflect the type of seal used rather than the magnitude of any leaks. Inspections of the primary seal can take from 15 minutes to 3 hours, depending on whether the seal is cracked. If the primary seal is in good condition, the secondary seal can be checked in 5 to 10 minutes. On the average, an inspector can check one tank per hour. Normally, an inspector will check no more than two tanks a day and four in a week. Tank inspections are announced, in accordance with the agency's regulations, at least 48 hours in advance. Because the agency personnel believe that it takes longer than 1 year for a seal to deteriorate to the point of noncompliance, storage tanks are inspected on an annual basis.

Bulk Plants

Because bulk plants require only a vapor balance system, there is no VRU or vapor holding tank to check. Most bulk plants have fixed-roof tanks, which require only a check of seams and pressure-release valves. The loading rack must be inspected, but it is not as large as a bulk terminal rack and so takes less time to inspect. Routine inspection for bulk plants involves 30 minutes to 1 hour. Inspectors also make sure that drivers are using good work practices, e.g., connecting the vapor return

line and not opening a dome hatch, which would allow the vapor to vent to the atmosphere.

Spot-Check Inspections

A spot-check inspection is done on a random basis when an inspector is in the vicinity of a terminal or plant. An inspector will drop in unannounced to make sure that the vapor recovery system is on and being used properly. He will check for obvious leaks on the loading racks and for normal functioning of the control system in general. This 15-minute inspection gives the inspector a chance to talk with the terminal operator to see whether there have been any problems, and it lets the terminal operator know that he is expected to operate and maintain the terminal properly at all times. If the inspector finds or suspects a problem, he may conduct a fuller inspection.

Violation Processing Procedure

For a problem not rising to the level of a violation, e.g., need for a minor adjustment of equipment or for replacing a worn part, the inspector may give a verbal notice to have it fixed and check it on his next inspection. If, however, there is any question of a violation, the agency encourages the issuance of a notice of violation (NOV), which provides formal documentation of the situation.

When a violation is found, an NOV is normally written immediately. After the NOV is written, the inspection report is reviewed by the relevant senior inspector, a field engineer, and the chief inspector to determine the nature of the violation and whether the matter should be pursued. If all of these people sign the report, the matter goes to the legal staff to determine whether evidence is sufficient to process the NOV. If there is sufficient evidence, a letter is written to the terminal manager (not the company owner) informing him that the violation has been referred for legal action and offering to settle the matter out of court. Informal settlement is favored over litigation as being less costly and time consuming, while being equally effective. The agency has found that the threat of court proceedings and stiff penalties provides sufficient inducement for sources to accept a settlement, pay the fee prescribed by an established schedule, and come into compliance.

Compliance Strategy

This agency considers the terminals and bulk plants to be important but not of the highest priority to its control efforts. Nonetheless, the agency's policy is for inspectors to maintain high levels of both communication with and presence at the sources. Because an inspector is assigned to a specific geographic area, there is a high sense of responsibility for ensuring compliance within each area. Inspectors frequently make informal visits to terminals or schedule a routine inspection between

other activities. As a result, a terminal facility can generally expect an inspector to visit once a month. Frequency varies, depending on the inspector's perception of the source's past compliance history. Regardless of past performance, the agency attempts to conduct annual source tests at each terminal.

More than 1,800 NOVs were issued in 1978, a reflection of agency policy to issue formal notices for all violations and assess small fines to keep sources conscious of their obligations. The system allows for expeditious correction of any problem. Additionally, the agency feels that, by relying on a uniform, formal compliance program instead of a haphazard system of informal verbal warnings and NOVs, it maintains more effective control of compliance activities.

When regulations to control bulk terminal and bulk plant emissions were originally proposed, there was considerable opposition. In the long run, however, resistance to the requirement for installation of vapor control equipment was minimal. The agency is now at a point where the staff feels only minor adjustments in its strategy are needed to secure compliance. To this end, inspectors are focusing less on simple indicators of a violation, such as obvious leaks, and more on the sources of problems: how equipment is installed, used, and maintained. Recently promulgated performance standards, for example, are geared to proper maintenance programs. Meanwhile, the agency's primary control efforts are shifting to Stage II regulation for service stations.

DISTRICT B

Background

The applicable regulations went into effect in 1972 in this district. The regulations require vapor recovery units on facilities with a throughput of 20,000 gallons per day or greater. Since no compliance schedules were established, all terminals had to operate on variances until the equipment could be installed. The variance period ended in 1975. This district now has 11 bulk terminals, all of which have some form of vapor control through vapor recovery or incineration. The agency's official policy requires 90% efficiency for vapor recovery systems, but for enforcement purposes the agency considers a 5% margin of error acceptable. Additionally, terminals must obtain an annual operating permit.

Agency Organization

This county district is qualified, under state law, to operate independently of the state agency. The inspection division is staffed solely by engineers. At the present time, one engineer working alone handles terminal and plant inspections. There are also a number of control officers whose responsibilities are limited to detecting opacity and odor problems in other source types. Since they are not organizationally located in the inspection division, no mechanism has existed to use them for bulk terminal inspections. The agency does plan, however, to establish a new job classification, called "process evaluators," within the inspection division. This will allow qualified control officers to assist engineers by conducting some of the more routine inspection tasks. This general augmentation of enforcement capabilities will allow the agency to implement new routine inspection procedures for bulk plants and service stations as well as terminals.

Inspections

Overview

The district relies on three basic inspection procedures to ensure compliance of bulk terminals: comprehensive source tests to determine VRU efficiency, routine inspections for permit renewal, and spot-check inspections. Additionally, VRU installation and initial performance are closely monitored.

Source Testing

VRU efficiency tests are conducted every 3 years; visits are announced. Stack samples are collected by an engineer and brought back to the laboratory for analysis, in contrast with the on-site testing method commonly used. This test is less expensive than those presently being considered for EPA adoption.

Routine Inspections

In general, a terminal's vapor recovery equipment is inspected by the engineer prior to renewal of the facility's annual operating permit. These visits are unannounced. The inspection process requires from 1 to 3 hours, depending on whether violations are found.

The inspector checks for leaks in the loading rack system, the pressure-release valves, and the dome hatches on trucks. The seals on floating-roof tanks are inspected for cracks and holes. VRU pressure and temperature gauges are checked against the range of acceptable operating standards noted by the engineer at the time of installation.

In addition to checking the equipment, the inspector observes the work practices of the truck drivers and terminal personnel to assure that the vapor control equipment is used properly. Finally, maintenance records are checked to determine how often equipment is serviced and whether unreported equipment failures have occurred.

Spot-Check Inspections

Spot checks are unannounced visits by the engineer to ensure that the vapor recovery equipment is being used and is properly maintained. The pressure and temperature of the vapor recovery system may be checked, and the loading rack and pressure-release valves are inspected for leaks. Spot checks take from 15 minutes to 1 hour, depending on whether problems are discovered. A more thorough inspection is generally scheduled (or simply conducted) where violations are identified.

Violation Processing Procedure

A terminal operator is required to notify the agency immediately when the vapor recovery system malfunctions. A letter notifying the agency that the problem has been resolved must be received within 10 days to avoid further agency action.

When a problem is identified during an inspection, the inspecting engineer assesses the significance of the situation and decides whether an NOV will be written. Depending on the situation, the engineer may give a verbal notice that a problem was found and that it should be corrected within a fixed time period. A compliance order, which is analogous to a formal verbal notice, may also be issued. After the problem is solved,

the terminal operator must submit a letter to the agency documenting the corrective action. This formal acknowledgment of the problem is included in the terminal's record.

If an NOV is written for a violation, the agency judges the severity of the violation and decides whether or not to seek civil or criminal action. Normally, if the terminal has had a good compliance record, the agency will establish a compliance schedule with terminal staff members. This will generally take care of the problem. The agency staff looks for a pattern of consistent breakdowns before taking court action.

Civil actions leading to the imposition of penalties are brought before the County Air Pollution Hearing Board. This board consists of people who are knowledgeable in air pollution problems (engineers, attorneys, and industrial representatives). Penalties under the civil board can be as great as $10,000 for the first violation and $2,500 per day for every day in violation.

Another option is to seek criminal action against the violator. These cases are heard by a district magistrate, who may impose fines ranging from $100 to $1,000 for a first-time violation and $500 to $5,000 for subsequent offenses.

The decision whether to pursue a case civily or criminally is based on a judgment about which action will get the fastest results. The object, agency staff noted, is to obtain compliance as quickly as possible, not necessarily to collect the largest fine.

The final action that can be taken against a violator is to seek an injunction, either to stop the operation of the facility until the problem is corrected or to close it down completely. This district has never had to use the injunction process for a bulk gasoline terminal.

Compliance Strategy

When hydrocarbon controls were first promulgated in the district, there was some resistance, including a court challenge. Over time, agency staff have developed good communication networks with the facilities, providing technical advice and limiting heavy fines to instances of bad faith. According to the agency, those problems that do occur usually stem from inadequate maintenance programs.

The agency has had to find ways of enforcing bulk terminal regulations with minimum resources because its main effort focuses on inspection and enforcement for other types of emission sources. Because of these limits on resources, yearly routine inspections and frequent spot checks of every facility are not possible. Inspection efforts focus on terminals with a history of breakdowns, particularly those using types of VRUs known by agency staff to be susceptible to malfunctions.

The agency's engineer is one of its most valuable assets in assuring the success of its enforcement program for bulk terminals. He is capable

and meticulous, interested in vapor recovery systems, and dedicated to his work. He consistently monitored the systems' progress from the beginning. His extensive and detailed knowledge of the vapor control equipment is a valuable resource to the agency, and he uses this knowledge to assist sources in resolving technical compliance problems.

DISTRICT C

Background

District C, a regional office of the state's Air Pollution Control Board, is responsible for part of a multistate metropolitan area. The jurisdiction of District C includes eight bulk gasoline terminals and a few bulk plants serving the rural areas. Volatile organic compound (VOC) emission regulations governing bulk terminals have been in effect since 1973, and the region began implementing Stage I controls in 1975. Both sets of rules were first implemented by sending letters to the operators of bulk terminals explaining the regulations and offering technical assistance.

The installation of controls on bulk terminals met little resistance. District staff reported, however, that significant amounts of inspector time were necessary during the first year (described as a "shakedown" period), while the sources corrected minor difficulties. More resistance was generated by the adoption of Stage II controls because the district held the terminals liable for deliveries to service stations without the required vapor balance system. One company was particularly resistant. After the agency commenced enforcement action against this company, the other companies moved quickly to comply.

Agency Organization

The agency is divided into three sections: the compliance, planning, and industrial divisions. The industrial section is responsible for source testing (although no source tests on bulk terminals have been done out of this office). The planning section handles permit evaluation and various kinds of technical support. The compliance section houses both the inspection and enforcement activities as well as permitting.

Two main types of staff are involved in bulk terminal enforcement: an engineer, who works mostly inside the office, and an air pollution control officer, working mostly in the field, who is responsible for all inspections. The former is a fully qualified engineer, while the latter has a bachelor's degree in environmental science.

Inspection

Overview

Two types of inspections are conducted in District C: an annual inspection and a spot-check inspection. Little attention is paid to how

the units are working or to technical problems, as such. Rather, the district relies on symptomatic indicators of noncompliance, e.g., vapor checks using an explosimeter.

Annual Inspection

The annual inspection of each bulk terminal takes about 1 1/2 hours and involves checks at the loading racks, the vapor holding tank, and the VRU, and a review of maintenance records. The loading rack inspection must be done while loading is occurring, preferably major loading. After checking to make sure that all lines are properly connected, the inspector checks for leaks at each connection and on the trucks with an explosimeter. The inspector then follows the line to the vapor holding tank, checking to make sure that the pressure vents are not releasing during minimal loading operation. He checks for vapor leaks around the vapor holding tank, which must be done while the bladder is full. At the VRU, the inspector uses the explosimeter on all joints. Finally, the maintenance records are checked to see how much downtime the unit has experienced, the reasons for the downtime, its duration, repair records, whether the agency was notified of the breakdown, and whether the same device seems to be repeatedly malfunctioning.

Spot Checks

Between the annual inspections, short spot checks are conducted at each source. The maximum duration of a spot check is a half hour. At this visit, the inspector will check whether the loading equipment is being used correctly and verify that the VRU is operating. The inspector reported that if the pressure vents are releasing vapors they will make a clicking sound. He will listen for this sound at times when they should not be releasing (moderate or minimal loading occurring) at the same time that he is looking for visible schlieren patterns. The site visit ends with a quick check of the maintenance records.

A number of criteria could trigger a fuller inspection during a spot check:

- If the maintenance log shows a number of recent problems.
- If truck drivers are not using the equipment correctly, indicating lack of operator surveillance.
- If the vents are breathing when they should not be.
- If any condition at the source indicates lack of maintenance.

The objective of the spot check is to prevent the source operator from thinking that district staff will be there only once a year. In addition, spot checks will be done more frequently at those terminals where county inspectors tend to spend little or no time.

Violation Processing Procedures

The selection of one enforcement procedure over another is based on the inspector's judgment about the source's record and probable response in light of the nature of the problem identified. The district staff believe in the efficacy of an initial informal warning as an enforcement mechanism. Thus, the inspector's first response to locating a problem will be to issue a verbal warning and schedule a subsequent inspection to check for compliance. Gradually, NOVs are issued only in cases of habitual or repeated problems.

Upon the issuance of an NOV, a source will be given a brief period of time to correct the problem. If this is not done, an enforcement action is undertaken. Sanctions available include summary criminal proceedings leading to fines, civil penalties, or administrative permit revocations. Since District C is a state regional office, it enforces state-level regulations that include these sanctions. In addition, however, city and county agencies that have received state certification may enforce on the basis of their ordinances in the same geographic area. Thus, summary fines, civil penalties, and permit revocations are also available to local officials and state staff will frequently request that the local agency initiate an enforcement action. This is done because of the long delays associated with prosecuting violations through the state headquarters office. The district's generally good relationship with its approved county agencies makes this option a real and viable one. Where, however, the local agencies cannot, or choose not to, prosecute a particular case, the state procedures will be triggered.

Compliance Strategy

VOC control is considered a fairly high priority in District C, although the staff is very small and, in its role as a regional state office, has a variety of other responsibilities. For bulk terminals and plants, district staff members believe that reliance on symptomatic indicators of noncompliance--e.g., detecting leaks--results in vesting greater responsibility in the companies to maintain compliance. This approach also makes it possible for an inspector with less than the qualifications of an engineer to single-handedly manage the enforcement effort at the eight bulk terminals in the district. In addition, assistance is provided from the state-certified local agencies within the district's jurisdiction.

The control officer in charge of bulk terminals is not empowered to issue criminal citations. Thus, the enforcement strategy stresses the development of respect among source operators for the inspector himself. Maintenance of close relations with county agencies within the district's jurisdiction is also considered an important factor.

DISTRICT D

Background

District D is an agency responsible for air pollution control in several adjoining counties comprising a large metropolitan area. Ozone has been recognized as a problem in the area for some time, and the VOC emission control program has existed for several years. In all, the agency is responsible for approximately 27,000 pollution sources. Among these are 38 pipeline-fed bulk gasoline terminals and 80 bulk plants.

Agency Organization

Three district divisions are primarily involved in bulk terminal and plant activities: enforcement, engineering, and technical services. The enforcement division includes both the inspection and enforcement activities. Engineering is responsible for all permitting, while technical services conducts source tests. A legal division determines whether cases referred by the enforcement division are to be processed criminally or civilly. It handles civil matters, while the counties' district attorneys handle the criminal cases.

Within the enforcement division, there are three staff levels: supervisor, engineering inspector, and tank inspector. The four engineering inspectors on the staff work in teams of two and are responsible for all inspection procedures except source testing and storage tanks. The tank inspectors, also working in pairs, perform the more physically demanding checks of storage tanks. Besides normal supervisorial duties, the supervisor reviews the ground for NOVs issued by inspectors before they are referred to the Director of Enforcement for further action.

Inspection

Overview

Besides the source test, the district conducts three types of inspections: the quarterly (comprehensive) inspection, the tank inspection, and the spot-check inspection.

Quarterly Inspections

These inspections are designed to be conducted quarterly, but it has proven difficult to get to all bulk terminals more than twice a year.

Consequently, the "quarterly inspection" of a bulk terminal is actually done between two and four times per year, depending on the size and prior compliance history of the source. Bulk plants receive an analogous inspection once a year.

Besides conducting the inspection itself, the inspectors are responsible for completing NOV forms when a violation is identified, writing inspection reports, and physically serving the source with the NOV when one is issued. As a result, the number of sources inspected works out to an average of about one per day per team, although the average inspection takes only 2 hours.

The inspection begins at the racks, because the likelihood that a large number of trucks are being loaded is better earlier in the day. One inspector works at the loading racks observing the operations and watching for leaks. Between truck loadings, the equipment on the racks is inspected for missing, worn, or broken parts. While the first inspector is observing loading operations, the second is checking the VRU, making sure it is operating and shutting on and off at the appropriate intervals. The agency believes that simultaneous checking of the racks and the VRU is important to determine whether the system as a whole is working properly.

The tank trucks are also checked to be sure that their state certification sticker is displayed and current, and that the vapor return hookups are in good order.

Finally, the inspectors review the source's records to ensure that they are being properly maintained and to see whether there have been any facility modifications. If such modifications have occurred, the inspectors will check whether the appropriate permits have been obtained.

Tank Inspections

As noted above, the storage tank inspections are conducted by a separate team of inspectors. These personnel climb the tanks and inspect the seals and pressure vents for disrepair and leakage.

Spot-Check Inspections

Because the district relies heavily on the frequency of inspections as a means to ensure compliance, the inspectors arrange to make periodic spot-check inspections, which last about 15 minutes. The source's operations are checked to see whether trucks involved in loading operations are properly hooked up to the vapor return lines and whether the VRU is running. Based on its experience with the occurrence of VRU maintenance problems and with VRU overloads during peak periods, the district considers checking to ascertain whether the VRU is actually running a particularly useful inspection technique.

Because the spot-check inspections are somewhat impromptu and occur between more formal and longer inspections, good information is not available on how many are done or on how many spot checks will be done on a given source. Nonetheless, it is known that the frequency of spot checks is determined not only by where the inspector happens to be geographically (with a little extra time) but also by the selection criteria for quarterly inspections.

Violation Processing Procedures

Once a problem is identified, the inspector must decide between two violation-processing approaches. The first is to conclude that the problem does not warrant formal action, resulting in the issuance of a warning. However, the district discourages the use of warnings, preferring the issuance of a formal notice in doubtful cases.

The second approach is to use a device recently adopted by the district--the Notice to Comply (NTC). NTCs are being used extensively for bulk terminals, bulk plants, and tank trucks in those cases where the problem is one that can be simply or immediately fixed. Essentially, the NTC is a notice that, unless the company involved files a report within 2 days indicating that the problem has been fixed, the NTC automatically becomes an NOV.

When an NOV is issued, it is reviewed to assure that adequate support for the finding exists before it is referred to the legal division. The inspector's supervisor makes an initial review and returns the NOV to the inspector if there is an obvious gap in the documentation. A more thorough examination for sufficiency is made by the investigation section (within the enforcement division), the staff of which maintain close liaison with the agency's attorneys and local district attorneys.

Upon referral to the legal division, the staff must choose between the available civil and criminal enforcement procedures. NOVs will generally be referred to district attorneys within the district's region for criminal processing unless they are selected by the agency's legal staff for civil action. Cases are selected for civil action if the agency believes that the case can be settled by a source's agreeing to correct conditions underlying the noncompliance, or if the nature of the violation is such that proof beyond a reasonable doubt (required in criminal cases) may be problematic. Although the civil penalty provisions require a showing of intent or negligence, this can generally be established by documenting more than one instance of the same problem at the same source (e.g., the same loading rack is leaking on two consecutive inspections). In these cases, penalties of up to $500 per day are available.

Compliance Strategy

VOC control is considered the highest priority in this district because of the long-time recognition of the area's ozone pollution problem

and the many VOC sources located in the area. Additionally, pressure from the state agency has required District D to devote more staff to bulk terminal and bulk plan inspections. How much manpower is needed, at a minimum, to maintain optimal levels of compliance is thus of prime and immediate concern to this agency. Overall, the agency believes that it is essentially on the right track in meeting its VOC control responsibilities with existing resources, and that any remaining problems require only fine-tuning of the present enforcement approach.

The agency's compliance strategy is characterized by a belief that inspector visibility is important to maintaining compliance and that the rules applied should be consistent with both compliance and enforcement capabilities. Differential treatment of sources is considered important, not only to correct problems in recalcitrant sources but also to provide something of an incentive for sources to police themselves.

Generally, more compliance problems are perceived to exist among independent sources, and some companies have reputations for being particularly troublesome. Thus, such devices as "one-company saturations" (i.e., concentrating inspector time on all the sources owned by one company for a specified period) are being employed. At the same time, as a result of economic pressures and increasing regulation, more and more bulk plants are becoming company (versus independent) operations. Such consolidation should facilitate compliance with the VOC rules, whether or not this trend is desirable from other standpoints. In addition, the agency has concentrated on particular parts of the facility at certain stages, to direct the sources' attention and also to effect a measured and planned improvement in overall compliance.

In summary, the district's enforcement approach emphasizes flexibility--the tactics employed now have changed from those used when the rules were first promulgated--and a belief that the job is possible to do.

APPENDIX B

COMMENTS RECEIVED FROM REVIEWERS

Appendix B

COMMENTS RECEIVED FROM REVIEWERS

Reviewers' comments on the draft report were extremely helpful in our efforts to identify gaps in our logic and areas where clarification was needed. Because these comments were so useful, we have reproduced the critiques and suggestions as part of this report.

Reviews from Regional EPA Offices

"This report appears straightforward in setting up various strategies that could be adopted by state or local air pollution control agencies for enforcing Volatile Organic Compound (VOC) regulations pertaining to the gasoline marketing industry. The agencies can select from the strategies the type of program(s) that will work best within the limits of their available manpower and expertise.

"Since the thrust of this report deals with methods to enforce the VOC regulations without a significant increase in manpower, we would like to suggest that emphasis should be placed on enacting SIP regulations that require the gasoline industry to record and periodically report data that can be used to indicate the operability and effectiveness of the control devices. As an example, the type of data that should be required for refrigerated vapor recovery units (VRU) would be the gasoline thru-put, gasoline recovered, and temperature ranges of the VRU exhausts. This type of information would require the sources to install and maintain a flow meter for the recovered gasoline and a thermocouple with a recorder. The cost of these two items is insignificant compared to that of the VRU. The recording requirements will make it necessary for the source to check the unit periodically (preferably daily) and this should help in maintaining the operability of the unit. The reporting requirement will enable the agency to easily find any problems that develop. This will help for prioritizing the inspection program. Refrigerated VRUs appear to be the predominant control type selected by the industry. Other control options could have similar data element recording and reporting requirements."

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"The SRI draft final report may prove to be a useful compendium of background and general information. However, the information on the status of SIP regulations is too dated to be reliable, and the discussion of enforcement is too general and conceptual to be of any real value. Detailed information on inspection techniques and source test methodology would be more useful."

"The report surfaced problems regarding the performance of control devices now used throughout the industry due to poor operating and maintenance practices and the problems the regulatory agencies would encounter in performing proper inspections through lack of trained and experienced personnel.

"With this in mind, the following suggestions are made for DSSE's consideration:

1. EPA's training center should start developing courses to train and upgrade the agency's present inspectors if they are to perform in a responsible manner.

2. Contacts with RTP have indicated that no reliable instruments for low level detection of hydrocarbons are available as of now. A project to develop portable and continuous monitoring instrumention should be initiated. Since this appears like a large market, specifications and criteria for such instruments should be available so that the instrument manufacturers can be involved.

3. Since the regulations are being proposed, it would be to the advantage of the EPA to include installation by the source of continuous monitoring systems to detect, record, and report concentration of hydrocarbon emissions during the loading and unloading at large terminals and bulk loading plants. The requirement should be included assuming that the instruments are commercially available and not too costly.

4. Provisions should be made in the regulations to require operating and maintenance procedures for VOC control equipment."

"The report delineates major problems associated with control effectiveness of vapor recovery units, but does not include tank truck leaks. Our experience has shown that leaks in tank trucks are one of the greatest contributors to reduced vapor recovery system efficiency. Aside from the obvious problem that results from loading a leaky truck, an obscure problem results unless each individual vapor return line is equipped with a check valve. Since all vapor return lines are manifolded into a common header, a leaky truck represents a short-circuit in the system. The vapors from all trucks loading concurrently with a leaky truck will be vented through the leaky truck and bypass the vapor recovery system. We have actually observed this in the field.

The installation of check valves in each individual vapor return line should be a requirement of an acceptable vapor recovery system. Since the integrity of vapor recovery systems depends heavily on maintaining leakless tank trucks, we feel that regulation of tank trucks warrants greater emphasis in this report.

"We have not found top-loading of trucks to be a problem. Virtually all facilities in our region that have installed vapor recovery systems have concurrently converted to bottom-loading.

"We concur with the report's assertion that source testing using the EPA recommended method is very expensive and time consuming. Our experience has shown that direct overhead cost for the equipment necessary to test one loading rack and vapor recovery unit ranges from $14,600 to $19,000. Personnel (four people) and miscellaneous costs are about $13,000. Thus, the total cost for the initial testing of one loading rack and vapor recovery unit can be as much as $32,000. Subsequent tests would cost $13,000. Testing of facilities having more than one loading rack would, or course, be more costly. For example, direct overhead cost for the equipment necessary to test three loading racks and a vapor recovery unit ranges from $28,000 to $36,600. Personnel (ten people) and miscellaneous costs are about $19,500. Thus, the total cost for the initial testing of a facility having three loading racks and a vapor recovery unit can be as much as $56,100. Subsequent tests would cost $19,500.

"The test typically takes 1 day to set-up, 3 days to run, and 1 day to disassemble the sampling apparatus. It usually takes 1 day to transport the equipment to the site, another day to write up the test results. There is little wonder none of the source test methods developed thus far has met with widespread acceptance."

"SRI's section on intergovernmental roles briefly explores the possibility of cooperation between government agencies with regard to enforcement or surveillance actions. The possibility of cooperative inspections between appropriate environmental agencies and governmental safety organizations should be investigated. If such organizations as OSHA require inspections similar to those illustrated in the SRI report, there is the possibility that an interagency inspection team could be developed. Such an approach would have the following advantages:

1. Sharing of funds--many local or state agencies may not have the funds to invest in explosimeters. However, pooling of funds for such purposes may allow purchases of detection equipment which in turn would greatly enhance the objectivity of this program.

2. Sharing of expertise--agencies not having the capability or manpower for highly technical personnel for this program may benefit from field experience with another agency's personnel.

3. Public relations--pooling inspections would most likely, in the case of "good" sources, result in an overall decrease in total government inspections. This may have a beneficial effect on the plant managers attitude towards the inspection.

"SRI in its final report should, if possible, explore in more detail the possibility of further cooperation among government agencies.

"A source of uncontrolled emissions at service stations not mentioned is known to occur during gasoline deliveries. This occurs when the service attendant climbs to the top of the tank of the delivery truck and opens the hatch to see if he has received all of his gasoline. In doing this, he releases all of the vapor captured during vapor recovery. The solutions to the problem are simple, but it should be addressed in the development of a new program."

Reviews from EPA Headquarters

"I have reviewed this report and I think it is pretty good. The compliance strategies are clearly designed for State and local agencies, and my only reactions concern the ability to utilize these same strategies at EPA Regional level. My only comments are:

1. This seems to be addressing "second generation" compliance problems, i.e., identifying violations and enforcing compliance at sources which have installed the basic control device, a vapor recovery unit. In one region, however, the enforcement effort has been directed simply at getting sources to install equipment. There are probably enough "first generation" compliance problems to keep EPA busy for a long time.

2. The enforcement model appears to contemplate heavy reliance on "informal" enforcement tools, i.e., something short of adversarial-type actions. The extent to which this is possible may vary greatly depending on the state and its regulations. Again, to use Region V as an example, in states which appeared to allow sources to comply through submerged loading rather than vapor recovery, sources have been quite litigious and resistant to EPA efforts to force them to install vapor recovery. I don't know how widespread a problem this may be.

3. I think the most significant compliance strategy identified by this report is discussed on page 27 of Volume I, concerning the economic benefit of pollution control. As is pointed out, a vapor recovery unit may be a unique air

pollution control device in that it recovers the primary product of the source. As the report points out, the economic benefit has not been empirically confirmed. I think greater emphasis should be placed on devoting local agency resources to a study of this issue, if the economic benefit of vapor recovery can be conclusively demonstrated, sources will be given an economic incentive to voluntarily comply with the regulations, significantly reducing the need for Agency monitoring and enforcement.

"The title of this report* is a misnomer, as it covers only one stage of the gasoline marketing chain, bulk terminals. A number of agencies have had regulations for several years on bulk plants and service station storage tank filling (Stage I). There are a number of enforcement problems related to the design and operation of control systems for these operations. There is no reason why they could not have been covered in this study.

"Only a few agencies have attempted regulating refueling of vehicles (Stage II). There is, thus, a limited amount of enforcement experience in this area. However, this experience might be valuable to indicate to other agencies the feasibility of adopting similar regulations.

"If the scope of this report is to remain as it now is, the title should be changed to reflect that it only covers bulk terminals. This could save time for many people who might look for information that is not there.

"The report states that the most critical problem at bulk terminals is the amount of downtime of the vapor recovery unit. It indicated that downtime varied considerably with type and make of recovery unit. This indicates that a technical study to accurately identify the relative downtime of the different types and makes would be worthwhile. This could lead to the development of more reliable and more efficient recovery units. The corrective measure for excess downtime was said to be the development of a realistic and enforceable operations and maintenance schedule.

"Another problem of vapor control systems was the venting of emissions from vapor holding tanks when their holding capacity was reached. The recommended solution was the installation of an automatic switch which would prevent further loading when the capacity of the vapor holder was reached. If this was actually enforced, it would force the installation of a larger vapor holder.

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*The original title of this report was "Enforcement of Emission Regulations for the Gasoline Marketing Chain."

"Switch-loading was described as the third most significant source of emissions. When a fuel of low volatility, such as diesel oil, is loaded into a tank truck whose previous load was gasoline, emissions are almost as much as when gasoline is loaded. Where such practices are common, vapor return lines should be added to the racks used to load normally uncontrolled fuels.

"Top-loading was described as a particular problem. Damage to the truck dome-hatch sealing surface by the nozzle is so common that a low level of leakage cannot be attained. The only solutions appears to be bottom loading.

"The bulk of the report is a description of the strategies used by agencies to enforce their regulations. SRI grouped the strategies into two general types, adversarial and joint enterprise strategies.

"Adversarial strategies rely upon sanctions to compel compliance. Three adversarial strategies were identified:

'Identify and notice, but otherwise ignore, minor violations, while maximixing frequency of inspections.

'Conduct a series of targeted, intense inspections and/or source tests.

'Initiate one or more lawsuits or enforcement actions to get the sources' attention.'

"Joint enterprise strategies assume that most sources are willing to comply with the rules and the best strategy is to create incentives for the source to comply. Four joint enterprise strategies were identified.

'Provide early and intensive technical assistance through the on-site visits of a qualified engineer.

'Educate sources on the economic benefit of monitoring the control equipment.

'Require the development and use of maintenance plans.

'Use findings from inspections to develop conditions to source operating permits.'

"The extended discussion of the above two types of strategies should assist agencies in tailoring their strategy to the capabilities of their resources and the attitude of the sources.

"In general this report has considerable merit, but it needs more identification of specific problems and how to cope with these situations."